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[Issued with Army Orders for August, 1921.]

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HANDBOOK

OF THE

40
W.O.
6809

**B.L. 60-PR., MARKS II & II*
GUNS**

ON

MARK IV FIELD CARRIAGE.

LAND SERVICE.

1921.

✓
LONDON:

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PAGE

PART II.

PART III.

PART IV

✓

PART V.

Care and preservation—	
Gun and fittings	43
List of lubricators on gun	44
List of lubricators on carriage	45
Buffer and recuperator	45
General, carriage and gears	51
Sighting gear	52

PART VI.

Compressor, air, portable	53
Care and preservation, with Running Instructions	53

PART VII.

Miscellaneous Stores—	
Bit, vent, 14 inch	56
Borer, vent axial, .303 inch	56
Box, obturator	56
Cleaner, piasaba, No. 17	56
Cover, breech	56
Cover, cradle and gun slide	56
Cover, muzzle, No. 4	56
Drift, No. 12	57
Funnel, filling, No. 3	57
Gauge, pressure, No. 5	57
Gauge, striker protrusion, No. 10	57
Handspike, lifting	57
Implements, ammunition—	
Key, No. 17	57
" " 18	58
" " 32	58
" " 48	58
" " 53	58
" " 59	58
Indicator, Fuze, B.L., 60 pdr.	58
Lanyard, firing, No. 35	60
Lever, front nuts, buffer and recuperator	60
Measure, filling hydraulic buffer, No. 1	60
Press, obturator	60
Pump, hand, suction and force, screw acting, No. 1	60
Pump, liquid, portable, No. 1, Mk. 1	61
Rammer and Sponge	61
Rimer, vent axial, .303 inch chamber, No. 2	61
Tool, adjusting isolating valve	61

PART VIII.

Ammunition—	
Table of	62
Cartridges	63
Projectiles	64
Fuzes	65
Tube, Percussion, S.A. Cartridge	72

PLATES

	No.
Gun body, Marks II and II*	I
Breech mechanism	II and III
Carriage, general arrangement	IV
Carriage, with gun in travelling position	IV _A and IV _B
Carriage, with gun in firing position	IV _C to IV _E
Axletree	V
Brake gear	VI
Elevating and traversing gear	VII
Section through trunnions	VIII
Hauling gear and housing gear	IX
Recoil indicator	X
General arrangement of buffer and recuperator	XI
Cut-off gear	XI _A
Carrier, No. 7 dial sight, No. 9	XII
Sight, dial, No. 7	XIII and XIV
Sight, dial, No. 1	XIV _A
Target testing sights	XV
Compressor, air, portable	XVI and XVII
Gauge, pressure, No. 5	XVIII
Method of connecting air compressor to trail and recuperator	XIX
Cartridges	XX and XXI
Shell, H.E.	XXII
Shell, gas	XXIII
Shell, shrapnel	XXIV
Fuzes	XXIV _A to XXIX
Tube, percussion, S.A. Cartridge	XXX

NOTE.—This book is corrected up to May, 1921. Any alterations which may be suggested should be forwarded direct to the Chief Inspector, Royal Arsenal, Woolwich.

HANDBOOK

OF THE

B.L. 60-PR. MARKS II & II* GUNS.

PART I.

INTRODUCTION.

The breech loading 60-pr. *Marks II and II** guns are mounted on *Mark IV* Field Carriages and are classed among the Medium Artillery. The guns differ from the earlier marks of B.L. 60-pr. guns principally in being about five calibres longer in the bore with increased M.V. and range (extreme range about 15,700 yards) and in being furnished on the underside with guides and gunmetal bearing strips fitting the slides of the *Mark IV* carriage.

The breech mechanism is of a later pattern with "Welin" type breech screw and minimum number of parts liable to wear or replacement.

The firing mechanism is of simple design for percussion firing with "Tube, percussion, S.A. Cartridge" and consists of an axial vent with longitudinal fire channel and chambered to suit the tube and a slide box "W" and percussion lock "P.J." The percussion lock slides vertically in the slide box and is operated by hand by means of an actuating lever. The striker is forced to the cocked position and the main spring compressed, by the action of the actuating lever when the latter is partially revolved to the open position, it is retained in the cocked position by means of the firing peg of the lanyard. The inner end of the striker is withdrawn within the face of the lock frame after firing by means of a retractor lever in the slide box on the first movement of the breech screw in unlocking.

A safety arrangement is provided in the form of a bronze safety shutter, controlled by the revolving movement of the breech screw, which serves to prevent the insertion of the firing peg into the lock until the breech screw is locked in the gun.

The gun is fired from the right side by means of a direct pull on the firing lanyard so as to withdraw the firing peg clear of the lock frame.

The carriage is designed to admit of the gun being fired between 4° 50' Depression and 35° Elevation.

The gun is mounted on a cradle along which it is free to recoil and return under the control of a hydraulic buffer and a hydro-pneumatic recuperator contained in a steel cylinder block which fits inside the cradle and is free to recoil with the gun; the piston rods of the buffer and recuperator, being nutted to the cradle cap, remain stationary.

The buffer, in principle, is of the rotating valve type, actually the recoil valve is a fixture, the piston being free to revolve. A cut-off gear is fitted to the cradle and buffer to shorten automatically the recoil as the elevation increases so as to prevent the gun fouling the ground or trail. In the event of the cut-off gear becoming damaged, fittings are provided to enable the gear to be set by hand. The recoil is approximately 54-inches with the gun horizontal and 24-inches at 35° elevation.

Improvements have been introduced in the construction of the glands and recoil cylinder pistons, so as to get rid of the small defects which have hitherto caused trouble and embody the improvements which experience has shown to be most necessary. The recoil cylinder has a replenishing tank, so as to ensure that the buffer is always full and thereby avoid excessive recoils.

The chief advantages of a hydro-pneumatic recuperator over a spring recuperator are:—

- (i) The speed of run-out can be regulated to a nicety resulting in an increased steadiness of the carriage.
- (ii) The troubles due to springs breaking or taking a permanent set are obviated.

The recuperator is fitted with a floating piston, the function of which is:—

- (i) To act as a barrier between the air and the liquid and so prevent aeration, *i.e.*, the mixing of the air and the liquid which occurs in action when the air and the liquid are in direct contact.
- (ii) To ensure the liquid sealing of the glands and act as an intensifier to prevent leakage of air by opposing a superior pressure of liquid to it.

A tell-tale rod is attached to the piston which serves as a guide to indicate when the correct amount of liquid is in the system when charging, it also indicates when the liquid requires replenishing.

Two very important points exist in connection with long recoil guns, which have great effect both on the steadiness of the gun, not only during recoil, but particularly during run-out, *viz.*: the centre of gravity of the gun with its recoiling parts usually overhangs considerably to the rear end of the cradle or gun slide at full recoil; this not only sets up heavy pressures on the slides, causing rapid wear of the sliding surfaces, but also operates against a smooth working of the gun during recoil and run-out and is very detrimental to the general steadiness of the carriage. In this equipment the cradle is prolonged to the rear and the disposition of the weights and centre of gravity of the gun and its recoiling parts is arranged so that overhang is avoided, the gun being always supported to the rear of its centre of gravity by the cradle. Again, the cradle is supported at the

centre by the elevating arc, thus avoiding twist or droop of the cradle at one side which sets up a lot of friction and wear on the guides and on the recoil and recuperator cylinder pistons. This ensures increased steadiness of the gun during recoil, as it avoids the tilting, binding and excessive wear which ordinarily occurs, and ensures smoothness during run-out.

The figure on page 19 shows the gun at the position of full recoil. It also shows the position of the centre of gravity of the recoiling parts.

The cradle is pivoted by trunnions to a saddle and between these the elevating gear is fitted, which is operated from the left side of the carriage.

The saddle is pivoted at its centre to the trail in front of the axle-tree in such a manner that its rear end can be moved laterally across the trail through an angle of 4° R and 4° L, the movement being controlled by the traversing gear, so that small changes in direction can be given without disturbing the spade. The traversing gear is operated from the left side.

The trail is mounted upon a 1st class "B" pattern axletree and No. 12 wheels and is provided with screw brakes which are for use when travelling. It is fitted with a spade on the underside at the rear to anchor the carriage and give the latter rigidity when in action.

The trail is constructed to permit of the gun and recuperator body being run back when travelling in order to distribute the load over the limber and carriage wheels.

The sighting arrangements consist of a bracket to take a No. 9 Carrier with No. 7 Dial Sight on the left side and a bracket with supporting pillar to take a No. 1 Dial Sight on the right side.

The carriage throughout is fitted with renewable bearings which may be easily replaced when found necessary.

The ammunition for this Equipment is the same as that used with the *Marks I to I*** Guns on *Marks I and III* Carriages.

PART II.

ORDNANCE.

PARTICULARS..

Material	...	...	...	...	...	steel (wire construction).
Weight, estimated	{	with breech mechanism	...	...	...	2-tons 3-cwt. 1-qr. 14-lb.
		without breech mechanism	...	...	...	2-tons 1-cwt. 3-qr. 22-lb.
Length, total	...	...	...	...	...	192.25-inches.
Bore	{	calibre	...	...	...	5-inches.
		length	...	...	...	185-inches = 37-calibres.
		capacity, total	...	...	...	3,905-cubic inches.
Chamber	{	diameter	largest	...	...	6-inches.
			smallest	...	...	5.3-inches.
		length (to base of projectile)	...	...	21.926-inches.	
		capacity	...	...	618.75-cubic inches.	
Rifling	{	system	...	...	...	polygroove, plain section.
		length	...	...	...	160.968-inches.
		twist	...	...	...	uniform, 1-turn in 30-calibres
		grooves	number	...	...	32.
depth	...		...	.05-inch.		
width	...		...	.327-inch.		
Firing mechanism	...	...	...	...	lock, percussion, "P.J." and box, slide, "W" with "Tube, percussion, S.A. Cartridge."	

MARK II GUN.

(Plate I.)

The gun is of steel and consists of an "A" tube, breech bush, a series of layers of steel wire, jacket and breech ring. The "A" tube extends the whole length of the gun and is furnished at the rear end with a breech bush prepared for the reception of the breech screw. Around the "A" tube extending over the chamber and a portion of the bore are wound successive layers of steel wire. The jacket is fitted and shrunk round the exterior of the wire and a portion of the "A" tube respectively and is secured longitudinally by means of corresponding shoulders on the "A" tube and jacket and the breech ring, which is fitted over the rear end of the "A" tube and screwed to the jacket. The breech ring is prepared for the reception of the breech mechanism and is provided with a lug on the underside for the attachment of the hydraulic buffer of the carriage. Securing screws are provided in the breech face to prevent the breech ring from turning when in position.

Projections are formed on the underside of the jacket provided with gun-metal bearing strips with fixing screws, fitting the slides on the cradle of the carriage. A steel stop plate is attached to the front end of the projections by two securing screws. A bracket to actuate the slider of the recoil indicator is attached near the front end of the projection on the left side. Four holes are prepared in the projection on the right side near the front end for the attachment of the gravity tank.

Lubricator guides consisting of a gunmetal body with two stop plugs and three oil channel cover plates are attached to the left and right sides of the gun body by fixing screws secured by keep pins. A filling plug with loop, chain, link and securing screw is provided in the upper side and three oil channels with cover plates are prepared in the lower side leading to lubricating pads and check washers in the guide projections and bearing strips of the gun. The pads are so arranged as to lubricate the guide ways in the cradle of the carriage when the gun is worked.

The central portion of the chamber is cylindrical, coned at the front and rear.

Two planes for clinometer are prepared on the upper side of the gun, one being on the breech ring and the other on the "A" tube near the muzzle.

Axis lines are cut on the horizontal axis on the left and right sides at the breech and muzzle. Vertical and horizontal lines are also cut on the breech and muzzle faces.

The actual weight of the gun (without breech mechanism) is engraved on the top of the jacket immediately in front of the breech ring. The Royal Monogram and a transverse line denoting centre of gravity (without breech mechanism) are also cut on the upper side of the jacket.

The nature, mark, register number, manufacturer's initials and year of manufacture are engraved on the upper side of the breech face.

A line is cut on the left side of the breech face at the horizontal axis and filled with red wax, to indicate the locked position for breech screw.

MARK II* GUN.

(Plate I.)

The *Mark II** gun differs from *Mark II* in being lined with an "inner A" tube extending from the seat of obturator and slightly projecting at the muzzle. The "inner A" tube is slightly tapered from breech to muzzle and is secured longitudinally by corresponding shoulders over the seat of obturator and in front of the chamber and the breech bush at the rear. The interior of the "A" tube is prepared with longitudinal grooves from the first shoulder to three inches from the muzzle to prevent any turning movement of the "inner A" tube when in position.

Mark II guns when lined with "inner A" tube on repair will have a (*) added to the *Mark*, and will then become *Mark II** guns.

GUN BALLISTICS.

Charges	{ Full ...	9-lb. 7-oz. Cordite M.D. or R.D.B.	15 or 16
	{ Reduced ...	6-lb. 6-oz. Cordite M.D. or R.D.B.	11
Projectiles, 8 c.r.h. weight with fuze ...	...	...	60-lbs.
Cubic inches in chamber ...	...	...	618.75
Density... ..	...	...	0.423
Total cubic inches in bore ...	...	...	3905
Volume of expansion ...	...	...	14.92

Muzzle velocity (approx.)	...	...	...	2145-foot seconds
Muzzle energy	...	...	...	1914-foot tons
Area of cross section of bore	...	...	...	19.635-square inches
Shot travel	...	...	...	163.074 ins.
Working pressure	...	...	...	17-tons per square inch
Energy per pound of charge	...	...	...	203-foot tons
Maximum range 35° elev. 8 c.r.h. projectile (approx.)	...	...	...	15,700-yards

BREECH MECHANISM.

(Plates II and III.)

The breech mechanism consists of the following principal parts:—

Breech screw.
 Breech screw retaining plate.
 Breech screw rotating cam.
 Carrier.
 Breech mechanism lever.
 Axial vent.
 Crosshead.
 Crank shaft.
 Crank shaft bearing.
 Shot guide.
 Slide box "W."
 Percussion lock "P.J."
 Safety shutter.

The *breech screw* is of the "Welin" type and is divided circumferentially into twelve equal portions which vary in diameter and correspond to the breech opening of the gun. Four of the portions are plain and the remaining eight threaded, the whole being arranged in such a manner as to provide a two-thirds bearing surface for the screw when locked in the gun, while a rotary motion through one-twelfth of a circle suffices to unlock the breech screw. When unlocking the breech screw the threaded portions of the screw having the larger diameter pass into the plain portions in the breech opening of the gun and the segments next in diameter into the spaces thus left vacant, thereby allowing the breech screw to be withdrawn.

The breech screw is recessed at the rear to fit over a pintle on the front carrier and is bored through the centre for the reception of the axial vent. It is secured on the pintle of the carrier by a *breech screw retaining plate* which admits of the screw being revolved through the twelfth of a circle in locking and unlocking. By depressing the eccentric actuating pin of the retaining plate against a spring it can be rotated through 180° the plate being thus drawn back flush with the recess in the breech screw for assembling or dismantling. This arrangement also permits of the carrier being withdrawn independently of the breech screw should the latter become fast in the breech.

A recess is formed in the rear face of the breech screw on the right side for the reception of the *crosshead* into which fits the inner end of the *crank shaft* which works in a *crank shaft bearing* in the carrier. To the outer end of the crank

shaft is secured the *breech mechanism lever* by means of which the crank shaft is partially revolved and the breech screw thus turned to the locked and unlocked positions.

A steel roller which revolves on an axis pin provided in a projection on the upper side of the rear face of the breech screw, engages the *breech screw rotating cam* on the breech end of the gun imparts a turning movement to the breech screw in closing.

The *carrier* which supports the breech screw when withdrawn is hinged to the right side of the breech by means of lugs on the gun and a hinge bolt. A pintle on the front of the carrier forms a pivot on which the breech screw turns and a bearing washer is provided under the lower side of the hinge joint.

The *breech mechanism lever* is secured to the outer end of the crank shaft by a securing screw and is provided with a catch with spring and spring retaining block with securing pin. A projecting lug is formed on the right side of the breech ring at the hinge joint and serves as a control arc over which the lower end of the breech mechanism lever rides in opening the breech and thus prevents the breech screw rotating as the mechanism is swung into the loading position. The lug is also used as a friction brake to control the swing out of the breech mechanism when opening the breech at angles of elevation, by slightly raising the lever. A recess is provided in the lug into which the lower end of the lever falls when the lever is slightly raised and thus retains the mechanism in the loading position. The lever is retained in the closed position by means of the catch in the lever engaging a steel catch plate in the carrier.

The *axial vent* consists of a steel bolt with mushroom head which passes through the centre of the breech screw and pintle of carrier and is secured in position by means of a spiral spring and the slide box "W" which is screwed over the outer end. A fire channel is prepared through the longitudinal axis of the bolt, chambered at the rear end to suit the "tube, percussion, S.A. cartridge."

The *shot guide* consists of a bronze guide block to facilitate loading which is hinged to the under side of the breech face and is automatically raised to the loading position by means of an actuating lever which engages an actuating plate on the under side of the carrier. The lever is supported by means of a bracket attached to the breech face.

<i>Box, slide, "W"</i>	} see under "Firing mechanism"
<i>Lock, percussion, "P.J."</i>	
<i>Shutter, safety</i>	

pages 12 and 13.

ACTION OF BREECH MECHANISM.

To open the breech. The catch breech mechanism lever is pressed down and the lever pulled to the rear; this causes the crank shaft to revolve and its inner end, acting in the crosshead, revolves the breech screw one-twelfth of a turn bringing the threaded portion of the screw into portions of larger diameter in the breech opening. As the breech screw is revolved it travels slightly to the rear due to the pitch of its threads and thus unseats

the obturator. The continued movement of the lever swings the breech mechanism clear of the breech and into the loading position where it is retained by the lower end of the breech mechanism lever entering its recess in the control arc; at the same time, the actuating plate on the underside of the carrier engaging with the actuating lever, revolves the shot guide into a vertical position in line with the breech opening.

To close the breech. The breech mechanism lever is depressed slightly to disengage it from its recess in the control arc and by means of the lever the mechanism is swung into the breech, the shot guide being revolved to the left clear of the breech opening. The roller on the rear face of the breech screw coming into contact with the breech screw rotating cam causes the breech screw to revolve and the threaded portions on the screw to engage with the threaded portions of the breech opening. The continued movement of the lever to the front revolves the crank shaft with crosshead and breech screw into the locked position which is indicated by corresponding lines cut on the rear face of breech screw and left side of breech being in alignment, at the same time the catch of the breech mechanism lever enters its recess in the carrier. As the breech screw revolves it travels slightly to the front due to the pitch of its threads thus seating the obturator.

FIRING MECHANISM.

The firing mechanism is designed for percussion firing with slide box, "W" and percussion lock, "P.J."

It consists of a steel vent bolt passing through the centre of the breech screw and the pintle on the carrier, being feathered to the latter to prevent it turning and is retained in the breech screw by means of a spiral spring and slide box "W." The vent bolt is prepared through the longitudinal axis with a fire channel and chambered at the rear end to suit the "tube, percussion, S.A. cartridge."

The slide box "W" in which the percussion lock "P.J." slides consists of a steel body prepared with a screw thread for attachment to the outer end of the vent bolt and is furnished with a retractor lever, extractor and lock-actuating lever retaining plunger and spring.

The percussion lock "P.J." consists of a steel frame which is arranged to slide vertically in the slide box "W." It is provided with an actuating lever with handle knob by means of which it is worked and furnished with a steel striker with firing pin and firing pin retaining staple, cocking cam, cocking cam cover with securing pin and main spring. A stop screw is provided in the lower end of the lock frame to limit the travel of the actuating lever. The striker is retained in the cocked position by means of the firing peg on the firing lanyard and is withdrawn within the face of the lock frame after firing by means of the retractor lever in the slide box on the first movement of the breech screw in unlocking.

A bronze safety shutter, actuated by the breech screw in locking and unlocking, is provided in the exterior of the carrier and

serves to prevent the insertion of the firing peg into the lock until the breech screw is locked in the gun.

A retaining pin with keep pin is provided in the left side of the carrier for retaining the slide box "W" and safety shutter in position.

The firing lanyard which is attached to the loop of the firing peg is pulled from the right side.

OBTURATION.

The obturator, which is of the steep coned type, is supported on the axial vent and is held tightly between the mushroom shaped head of the latter and the front face of the breech screw by the spring and slide box "W."

The pad consists of asbestos worked up in mutton suet or rape oil to a proper consistency, enclosed in a strong canvas cover and pressed into shape in a hydraulic machine. When rape oil is used the pads are marked with the words "Rape Oil" on the canvas cover in black paint.

It is enclosed between a front copper protecting disc, around the outer edge of which is a split steel ring and rear inner and outer steel rings, the outer one being split.

The disc is stamped with the word "Front" and the pad has the word "Front" stencilled on the side which corresponds with the front disc and "Rear" on that which corresponds with the inner and outer rear rings to facilitate assembly on the vent.

If correctly assembled, the whole should fit together compactly.

Thin steel adjusting discs are provided for insertion behind the rear steel rings and pad when found necessary.

Action.—When the breech screw is swung into the gun the obturator enters the chamber with ease; on turning the breech screw the pad is pressed home into the coned seating of the gun by the travel of the screw. The bore is thus closed by the pad, which is in contact with the bore all round its circumference, while the mushroom head of the axial vent receives the force of the gas on discharge. On firing the gun the pressure acts on the mushroom head of the vent and compresses the pad against the breech screw, thus causing it to expand. This expansion is radial to the axis and equal in every direction and is sufficient to prevent the escape of the gas. On the pressure being removed elasticity comes into play and the obturator can be withdrawn from the coned seating as soon as the screw is unlocked.

Full instructions regarding the fitting, testing, adjusting and treatment of obturating pads and discs are contained in "Regulations for Magazines and Care of War Matériel."

TO DISMANTLE THE BREECH MECHANISM.

Before removing mechanism, the lock and breech must be opened and the breech mechanism swung into the loading position.

"P.J." lock, "W" slide box and axial vent.—Remove keep pin from retaining pin in the left of the carrier, partly withdraw retaining pin.

Unscrew lock and slide box from axial vent.

Withdraw spring axial vent and axial vent with obturator.

Breech screw.—Insert a screwdriver in the slot of the “pin, actuating, retaining plate,” pressing the pin and partially revolve it by the means of the screwdriver until the indicating arrow on the pin corresponds with the middle of the word “dismantle” on the breech screw. Withdraw the breech screw from the front end of the carrier.

Roller.—Remove the keep pin and roller axis pin and withdraw the roller.

Safety shutter.—Partly release the stop screw and withdraw the pin retaining slide box and safety shutter.

Revolve the safety shutter until the feather coincides with the featherway in the carrier. Withdraw the safety shutter to the rear.

Breech mechanism lever, crank shaft and bearing.—Swing the carrier and breech mechanism lever into the closed position. Withdraw the keep pin and the bolt securing crank shaft bearing.

Withdraw the bearing and crank shaft with the breech mechanism lever from the carrier and receive the crosshead from the inside of the carrier. Remove the screw securing the breech mechanism lever and withdraw the lever from the crank shaft.

Catch, retaining, breech mechanism lever, closed.—Remove the pin securing the retaining block; slide the block with spring complete to the lower end of its recess and withdraw.

Carrier.—Withdraw the keep pin from the hinge bolt. Remove the hinge bolt, carrier and bearing washer.

Shot guide.—Withdraw the keep pin and securing nut from the shot guide stud. Remove the guide block. Remove fixing screws from the bracket actuating lever and remove bracket and “lever, actuating, guide block.”

TO ASSEMBLE THE BREECH MECHANISM.

The breech mechanism is assembled in the following order:—

1. Shot guide.
2. Carrier.
3. Safety shutter.
4. Breech screw with crosshead in position.
5. Catch, retaining, breech mechanism lever, closed.
6. Breech mechanism lever, crank shaft and bearing.
Close the breech, taking care to see that the breech screw is fully locked. See that the crosshead is in the centre of the recess for the crank shaft, place in the breech mechanism lever, crank shaft and bearing together. Secure the bearing by its bolt and keep pin.
7. Axial vent with obturator.
8. Spring, axial vent.
9. Lock and slide box.

TO DISMANTLE THE “P.J.” LOCK AND “W” SLIDE BOX.

Lock.—Close the lock and remove the keep pin and securing pin of the cocking cam and cover. Withdraw cover and cocking cam. Remove the stop screw of the actuating lever. Turn the actuating lever downwards (left-hand screw) until vertical. Withdraw lock from slide box. Unscrew the actuating lever from the lock frame. Withdraw the mainspring and striker.

Slide box.—Withdraw the extractor. Withdraw the keep pin and plunger retaining lock and actuating lever with spring. Remove the retaining screw and retractor lever.

TO ASSEMBLE "P.J." LOCK AND "W" SLIDE BOX.

The lock and slide box are assembled in the reverse order.

TO TEST THE PROTRUSION OF THE STRIKER.

The lock must occasionally be removed from the slide box and the protrusion of the striker tested. With the "gauge, striker protrusion, No. 10," the firing pin should foul the minimum and clear the maximum recess, if not, the striker must be exchanged.

PART III.

CARRIAGE, FIELD, B.L. 60-pr. MARK IV.*(Plates IV. to IVe.)*

The following are the principal parts of the carriage:—

- Saddle.
- Cradle.
- Trail.
- Axletree and wheels.
- Brake gear.
- Traversing gear.
- Elevating gear.
- Hauling gear.
- Housing gear.
- Hydraulic buffer with cut-off gear.
- Hydro-pneumatic recuperator.

GENERAL REMARKS.

The carriage has been designed so as to allow the gun to have a considerable increase in range, the maximum elevation obtainable being 35° as compared with $21^{\circ} 30''$ in the present Service Equipment. It also has much better stability at low angles of elevation and is designed to give greater steadiness on the target at all angles of traverse.

The length of trail, the firing height, the weight of the recoiling mass and the length of recoil are proportioned to each other so as to contribute to the stability of the carriage; the vertical stability of the carriage, the additional support given to the cradle by having an elevating arc at the centre and the rearwardly extended cradle (the length of which is arranged so that the centre of gravity of the recoiling mass is always supported), all contribute to the lateral steadiness of the gun on the target.

The arrangements are simple for filling the buffer and recuperator cylinders and for charging the reservoir with compressed air. No parts of the cradle require to be dismantled for this purpose. Leakage of oil may be replenished without releasing the air pressure in the recuperator and this can be done without any risk of overcharging by observing the position of the tail-rod on the floating piston.

The carriage has cross levelling and automatic drift correction on the sight, automatic variable cut-off gear regulating the recoil and an oil reservoir providing a reserve of oil for the buffer.

PRINCIPAL DATA.

Weights.

Average weight (fully packed with stores as shown on packing diagram) :—

		Tons.	cwts.	qrs.	lbs.
Carriage with gun and limber	...	6	7	0	14
Carriage with gun	...	5	10	0	14
Carriage	...	3	6	3	0
Limber, carriage	...	—	16	2	0
Gun and mechanism	...	2	3	1	14
Weight on { carriage wheels } gun in travel-		4	2	2	21
limber wheels } ling position		2	4	1	21
Weight on pole (carriage } travelling position		—	—	1	14
limber) at 3rd tug hole } firing position		—	—	3	0
	{ on ground, gun in firing position.	—	1	2	0
Pressure of trail	{ on pintle of limber, gun in firing position.	—	—	—	9
	{ on pintle of limber, gun in travelling position.	1	7	3	21

Dimensions.

Distance	{ trunnions to axle (horizontal)	...	1-ft. 9-ins.
	{ between carriage and limber axles when limbered up	...	15-ft. 9-ins.
	{ to axis of gun	...	4-ft. 8-ins.
	{ to axle	...	2-ft. 6-ins.
Height	{ to No. 7 dial sight eyepiece	...	4-ft. 9 $\frac{3}{4}$ -ins.
	{ to No. 7 dial sight line	...	5-ft. 4 $\frac{3}{8}$ -ins.
	{ to trunnions	...	4-ft. 3-ins.
	{ of recoil at horizontal	...	54-ins.
	{ of recoil at 35° elevation	...	24-ins.
	{ muzzle to tip of No. 19 draught pole, travelling position	...	34-ft. 1-in.
Length	{ muzzle to tip of No. 19 draught pole, firing position	...	40-ft. 10-in.
	{ of gun and carriage	...	24-ft. 10 $\frac{1}{2}$ -ins.
	{ of trail (axle to spade)	...	11-ft. 4 $\frac{1}{2}$ -ins.
Locking angle, carriage and limber	...	...	35°
	{ width of carriage over axle	...	8-ft.
Maximum	{ of elevation	...	35°
	{ of depression	...	4° 50'
	{ of traverse, R. or L.	...	4°
Space required to turn in	...	...	60-ft.
Spade	{ depth (approx.)	...	1-ft. 2-ins.
	{ width	...	4-ft.
Turns of handwheel	{ per degree elevating	...	1
	{ per degree traversing	...	4
Wheels	{ diameter	...	5-ft.
	{ width of tire	...	6-ins.
Track	...	...	6-ft. 7-ins.

OTHER DATA.

Air reservoir	{ initial pressure	...	600-lbs. per square inch
	{ final pressure	...	1220-lbs per square inch
Diameter	{ of air reservoir	...	5.75-ins.
	{ of buffer cylinder	...	4.1-ins.
	{ of buffer piston rod	...	2.2-ins.
	{ of elevating pinion	...	5.613-ins.
	{ of recuperator cylinder	...	3.875-ins.
	{ of recuperator piston rod	...	1.6-ins.
Maximum force of recoil	{ of tail rod	...	1.25-ins.
	{ at horizontal	...	9-tons
	{ at 35° elevation	...	23.5-tons
Radius of elevating arc	...	...	24.175-ins.
Ratio of compression	...	...	1.7-1
Reserve of power at 35° elevation	...	...	25 %
Total liquid	{ in buffer cylinder and gravity tank	...	24-pints
	{ in recuperator	...	27-pints
Velocity of recoil	...	...	27.7-f.s.

SADDLE.

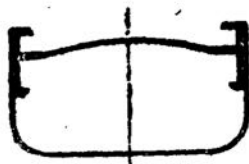
The saddle consists of two nickel steel side pieces connected by a front and rear transom. The front transom is provided with bushed bearings to take the cross-shaft of the elevating gear and clips are formed which engage with clips on the trail to prevent the front end of the saddle lifting on firing. The rear transom has a circular opening in its centre to take the traversing pivot by means of which the saddle is pivoted to the trail. The traversing pivot, which is of tubular steel, passes through the openings prepared for it in the trail and transoms and is secured in position by a nut and keep pin. Trunnion bearings are formed at the top of the side brackets for the reception of the cradle trunnions which are held in position by capsquares and pins. At the rear end of each side piece clips are bolted which engage with clips on the trail to prevent the rear end of the saddle lifting on firing. A steel bearing strip is riveted to the underside of each side piece near the centre. A bracket is bolted to the right side piece to take the pillar of the *No. 1 Dial Sight* and a pointer fixed to the left side piece reads to an elevation scale attached to the supporting bracket of the sight carrier to indicate the elevation of the gun. Four steel hooks to take the standing ends of the hauling ropes are screwed to the side pieces, two in front and two in rear of the trunnion bearings.

CRADLE.

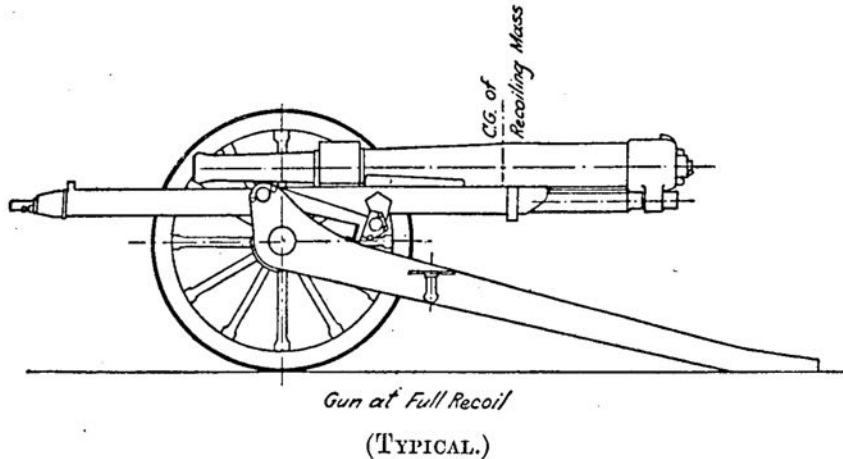
(See Plates IV. and VIII.)

The principal features of the cradle are:—

1. It is of enclosed box section so as to obtain maximum rigidity.



2. A long extension to the rear of the breech so that the gun and recuperator are supported during the full recoil, the centre of gravity of the recoiling mass never leaving the cradle.



The cradle body is built up of steel plate, the bottom and sides being formed in one piece with a stiffening plate and strengthened by front and rear bands; it is also stiffened by two longitudinal T-shaped bars riveted to the bottom. The sides are connected by a top plate in which are formed top guideways to take the guide ribs of the gun and under guideways in which slide the guides formed on the cylinder block. The front end is closed by a cradle cap to which is attached the piston rod of the hydraulic buffer and the ram of the recuperator; the cap is furnished with handles to facilitate its removal and with hinged doors at the bottom to enable the glands to be tightened without removing the cradle cap. A steel bracket is bolted to the top plate at the front end; it is fitted with a compressed leather pad with securing plate to act as a beating face to the gun in running up. Trunnions are provided one on each side for supporting the cradle in the bearings of the carriage, the left trunnion being formed with an extension to take the arm of the carrier for the *No. 7 Dial Sight*. Each trunnion is fitted with a roller bearing to reduce the friction and thus lighten the work of elevating and depressing the gun. A cap with flange to fit outside the trunnion bearing is screwed into the right trunnion and retained by a set screw; the left trunnion is fitted with a screwed collar retained in a similar manner.

A recoil indicator (*Plate X.*) consisting of a steel strip graduated in degrees and inches to agree with the table on page 26, is screwed to the top of the cradle on the left side; it is read by a slider dovetailed to the strip. The slider is actuated by a bracket screwed to the front end of the guide rib of the gun.

To prevent any longitudinal movement of the piston rod when the gun is in the travelling position a stop is fitted to the cradle at the rear end. The stop which is of gunmetal, is pivoted to an axis pin on the underside of the cradle and is formed with a

projection which, when the stop is raised to the travelling position prevents any movement of the piston rod. A steel pin is provided to retain the stop in the travelling or firing position.

Note.—Care should be taken that the stop is raised and secured by the pin before moving the equipment in the travelling position otherwise damage to the piston rod will result.

TRAIL.

The trail consists of two nickel steel side brackets joined at the rear by a top and bottom plate and at the front by a transom. The transom is in plan V-shaped and is formed with an extension which is attached to the axletree and pierced vertically to form a socket to take the traversing pivot of the carriage. A M.B. clip is bolted to the top of each side bracket near its centre along which clips on the rear end of the carriage slide. The front end of each bracket is faced with a M.B. strip on which the front end of the carriage rests; it is also fitted with holding down clips to engage with clips on the front end of the carriage. Intermediate bearing strips of M.B. are riveted to the top of the trail brackets one on each side. Bearings are fitted on each side near the front for the attachment of the axletree body and arms and brackets are fitted to each side piece for the attachment of the brake arms and cranked levers. A bracket to take the bar supporting cradle when in the travelling position is riveted to the top of each side bracket near the centre. The rear end of the trail is fitted with a spade and trail eye and a lifting handle and handspike bracket on each side for lifting purposes. Clips to hold the portable air compressor in position by means of 2 "Bars securing compressor" whilst charging the recuperator are riveted to the top plate. The trail eye is fitted with a repair bush. A G.M. slide riveted to the top plate of the trail forms part of the gear for housing the recuperator body in the travelling position. The trail is furnished at its front end with a draught link which serves to connect another carriage when travelling in series.

When not in use the draught link is housed by means of a wire rope slung to the cradle cap. The sling is a galvanised steel wire rope with thimble and spring hook.

AXLETREE AND WHEELS.

(Plate V.)

Axletree.—The axletree, which is the 1st class B No. 315, is made in three sections consisting of a body and two arms.

The body is tubular and passes through bearings in the trail sides; it is held in position by nuts which are screwed on the body and tightened against the inside of the trail. The nuts are prevented from unscrewing by the insertion of split pins.

The arms are each formed with a crank at their inner end which is bored to fit on the body projecting through the trail sides and flanged for the fixing bolts; when in the correct position they are each secured to the body by a screw and washer and to the trail by the fixing bolts. In this position the centre of the axletree body is about $5\frac{1}{4}$ -inches lower than the arm centre. A dust excluder consisting of a "L" shaped leather ring with keep plate, is secured

to a carrier and fitted on the shoulder of each arm to prevent the ingress of grit or dust. The outer end of each arm is fitted with a linch pin and an adjusting collar. The collar has a number of recesses cut in its outer face through which the linch pin passes; the recesses vary in depth from .2 to .5 inch, increasing by .05 inch, so that any reduction in the length of the pipe box, due to wear, may be compensated for.

Wheels.—The wheels are 1st class "B" pattern, No. 12, *Mark I.*, of double spoke construction, 5-feet in diameter, with a 6-inch \times $\frac{3}{4}$ -inch steel ring tire with rounded edges.

The nave consists of two M.B. flanges and a M.B. pipe box, which is in one casting with the back flange. The inner end of the pipe box is shaped to fit into the dust excluder on the axletree, while its outer edge is screw threaded to receive a M.B. bearing for the drag washer and a dust cap. The bearing screws up against a shoulder on the pipe box; it forms a stop for the dust cap, the latter being secured to it by two pins. The pipe box is shaped internally to fit over the axle arm and is provided with two grease boxes.

The drag washer is free to revolve around the bearing and is held in position by the dust cap.

The front flange is bolted to the back flange by 14 nave bolts which pass in between the feet of the spokes and are nutted up front and back alternately.

The spokes are of oak, 14 in number, the back spokes are dished, the front ones being straight. Their upper ends fit into spoke shoes which are riveted to the felloes. The felloes are of ash, seven in number, connected together by the tongue of every alternate spoke passing into the joint, thus forming dowels. The tire is held on the felloes by 14 bolts, two to each felloe, they are countersunk on the outside and nutted up on the bosom of the felloe.

The wheels are held on the axle arms by the adjustable collars and linch pins mentioned above.

In some cases extension felloes are fitted to the outer face of the wheel. They are of ash, 7 in number and are secured by clip bolts which fit around the spokes close to the bosom of the felloe. The bolts pass through the extension felloes and are nutted up on the outside. The sole of each extension felloe is fitted with a steel strake, secured to the felloe by screws.

BRAKE GEAR.

(*Plate VI.*)

The tire brake which is for use when travelling is of the swinging arm type and is so arranged that it can be actuated by means of the handwheel on either side of the trail in front of the axletree. It consists chiefly of two brake arms, two actuating rods, four cranked levers and an actuating screw. Each brake arm is pivoted at its inner end to brackets on the trail and provided at the outer end with a brake shoe fitted with a cast-iron brake block to act on the wheels. The cranked levers are pivoted in pairs to brackets on the trail in front of the axletree, two on each side. One arm of each lever is connected to the brake arms by means of an actuating rod. The rear

end of each actuating rod is fitted with disc springs to give the necessary resilience to the gear to prevent the wheels becoming dead-locked. To the front arm of each cranked lever is pivoted a G.M. actuating nut in which works an actuating screw spindle. The screw spindle passes under the side brackets of the trail and carries at each end a handwheel.

TRAVERSING GEAR.

(Plate VII.)

The traversing gear is interposed between the trail and the rear end of the carriage on the left side. It is mounted in a M.B. pivot which is supported in a bracket on the trail. Held in the pivot is a traversing screw, the right end of which works in the left end of a traversing nut which is hinged at its right end to a bracket on the carriage. A steel cover, screwed and pinned to the pivot, envelops the screw and nut to prevent the ingress of dirt or dust. Near the left end of the traversing screw a flange is formed and between this and the bearing in the pivot are placed Hoffmann ball bearings. The outer face of the pivot forms a gear casing and feathered to the traversing screw at this point is a spur wheel, between the boss of which and the bearing in the pivot is another set of Hoffmann ball bearings. Gearing into the spur wheel is a pinion on a short spindle supported in bearings in the gear casing, the outer end of which carries a handwheel for working the gear. The gear is closed in by a cover which is bolted to the casing.

The traversing nut is graduated up to 4° Right and Left, subdivided into 10 minutes, the graduations being read by a reader on the steel cover.

One complete turn of the handwheel equals 15 minutes of traverse.

ELEVATING GEAR.

(Plate VII.)

The elevating gear which is actuated from the left side of the carriage consists of an elevating arc, shaft for arc pinion and wormwheel, worm and worm shaft with handwheel.

The elevating arc is bolted to the underside of the centre of the cradle and the cross-shaft which carries the pinion and wormwheel is supported in bearings in the front transom of the carriage; the wormwheel is keyed to the left outer end of the cross-shaft and the pinion about the centre where it gears with the arc. The worm shaft which is supported horizontally in bearings at each end, extends the whole length of the carriage; it carries the worm at its front end which gears with the wormwheel and is provided with a handwheel at its rear end by which motion is imparted through the worm and wormwheel and pinion to the arc. The worm shaft is fitted with thrust washers at either end of the worm and an adjusting bush with locking plate at the front end.

The worm and wormwheel are enclosed in a gear case.

One revolution of the handwheel is equivalent to one degree of elevation or depression.

Note.—The last motion of the handwheel should be one of elevation.

HAULING GEAR.

(Plate IX.)

The hauling gear which is used for shifting the gun and recuperator body from the firing to the travelling position and vice versa, consists of a crosshead and two hauling ropes. The crosshead is of hollow steel, \square in section, packed with wood and provided at each end with a M.C.I. sheave. At the centre of the crosshead a G.M. muzzle plug to suit the diameter of the bore, is riveted. The reverse side of the crosshead is shaped to fit over the breech mechanism; when in position its centre is approximately in line with the axial vent. The hauling ropes are of Manilla, 3-inches in circumference and 42-feet long, formed with an eye at one end and fitted with a thimble.

HOUSING GEAR.

(Plate IX.)

The gear for securing the gun and recuperator body in the travelling position consists of a gun housing slide, two wire securing ropes, a cradle supporting bar and a locking pin. The slide is of gunmetal, shaped to receive the recuperator body and is riveted to the top plate of the trail. The securing ropes differ only in overall length; each consists of a length of steel wire rope fitted at each end with an eye and adjustable shackle with lock nuts; when in the travelling position the front rope is secured to hook brackets riveted to the trail above the spade; the rear rope is secured to hooks on the underside of the trail brackets. The bar for supporting the cradle is of steel, its upper surface is shaped to receive the rear band of the cradle; the bar is secured in position by means of two supporting brackets which are riveted to the top of the side brackets of the trail, one on each side. Each bracket is formed with a stud which fits into a recess at each end of the bar. The locking pin, which is of steel, passes through brackets on the top plate of the trail and fits in a square recess formed in the lug of the gun; it is furnished with a ring to facilitate insertion or removal and is retained in position by a split pin.

HYDRAULIC BUFFER, &C.

(Plate XI.)

The hydraulic buffer and recuperator cylinders are formed in a steel cylinder block constituting a recuperator body which fits inside the cradle and is provided with a guide each side to fit in the guideways on the underside of the top plate of the latter. The body is connected at its rear end to the lug of the gun and thus recoils with it, while the piston rods of the buffer and recuperator are nutted to the cradle cap and so remain stationary on recoil. Three parallel openings are bored through the cylinder block, viz.: a large central opening to form an air reservoir in which works a floating piston, an opening on the right to form a hydraulic buffer cylinder and one on the left to form a recuperator liquid cylinder.

Hydraulic buffer.—The buffer cylinder has two spiral grooves cut in its interior surface to rotate the piston during recoil. The front end is closed by a steel stuffing box which is screwed into it against a steel ring and fibre washer to make a tight joint. The stuffing box packing consists of a M.B. supporting ring inserted from the front. In front of this is placed a ring of "Dicks" packing, supported by a M.B. ring secured in position by a M.B. gland. The stuffing box is prevented from unscrewing by a locking plate and the gland by means of a locking pawl. The rear end of the buffer cylinder is closed by a steel plug which is screwed in on a fibre washer to make a tight joint and is kept from unscrewing by a locking plate. The plug is formed with an extension which is bored out to form a control chamber. A small passage is bored through it which places the control chamber into communication with the buffer cylinder. This passage is closed by the stem of an adjustable valve which is operated by worm gearing, the worm spindle being formed with a square recess to take the tool by means of which the rate of run up of the gun is regulated. Leakage past the valve is prevented by a ring of asbestos packing with neck rings and a gland.

The piston rod is of steel in one forging with the control plunger. The rod, which is hollow throughout its length and closed at its front end by a screwed plug lettered "D," passes out through the packing at the front end and is nutted to the cradle cap. The nuts securing the piston rods are of special design to enable them to be readily removed when shifting from firing to travelling position. Behind the securing nut, inside the cap, the rod has feathered to it a steel collar, on which is formed a toothed segment, which forms a part of the cut-off gear. A shoulder is formed on the rod in front of the control plunger which forms a bearing for the recoil valve in front and the piston in rear. The recoil valve, which is of steel, is fixed to the piston rod in front of the shoulder by a set screw; it has three shaped ports, which, in conjunction with the openings cut in the piston, regulate the recoil. The piston is of M.B. and fits loosely over the piston rod around which it is free to revolve. Externally it has two studs or feathers to work in the spiral grooves of the buffer cylinder and three radial openings are formed for the passage of the liquid. Its front end is held up against the shoulder formed on the piston rod by four anti-friction washers of steel and metal alternately; in rear of the washers a steel collar is feathered to the piston rod, the whole being held in position by a securing nut and split pin.

The control rod projects from the rear of the piston and has a flat cut on it for the greater part of its length, the flat tapers off towards the front end. The remaining portion of the rod is cylindrical and is a close fit inside the control chamber.

A snifting valve is fitted in the front end of the buffer cylinder; it is actuated by a spindle which extends along the right side of the cylinder block and is fitted with a loop at the rear end, the valve is operated by a pull to the rear. This arrangement permits

of air being released which may have accumulated in the buffer cylinder.

The front end of the buffer cylinder is provided with an air hole lettered "A" which is closed by a screwed plug similarly lettered. Normally air is released by means of the snifting valve.

GRAVITY TANK.

A G.M. gravity tank to hold 5 pints of liquid is bolted to the right guide rib of the gun at the front end; its duty is to replace any liquid lost from the buffer due to leakage past the glands, &c. The tank is provided with four openings:—one at the top for filling purposes, one at the front fitted with a sight glass and a brass diaphragm, which acts as a tell tale and indicates the liquid level, one at the bottom in rear, which places the tank in communication with the rear end of the buffer cylinder by means of a copper feed pipe and one at the top of the tank which is closed by a gun-metal cover with dermatine† washer, this permits of the tank being cleaned out when required. The filling hole is fitted with a brass gauze strainer and is closed by a screwed plug with dermatine washer. A small relief valve is nutted to the bottom of the plug and fits inside the strainer.

To prevent a vacuum forming in the tank, six holes are bored vertically through the filling hole plug and are closed on the underside by a dermatine washer, which is held in position by the nut securing the relief valve; the nut is rounded to allow of movement of the washer.

An isolating valve is fitted to the copper feed pipe near the rear end; this enables the tank and pipe to be cut off should they become damaged.

CUT-OFF GEAR.

(Plate XI A.)

The cut-off gear is intended automatically to shorten the recoil as the elevation increases and so prevent the gun fouling the trail or ground. It is carried on the right side of the cradle and consists chiefly of a cam, cam lever, actuating link, a short vertical lever and two bevel segments. The cam, which is of steel, is riveted to the right side of the cradle; it is formed with a cam groove in which works a cam roller. The cam lever is L-shaped and is pivoted at its centre to an axis pin on the inside of the right bracket of the carriage; the rear arm of the lever is provided with a roller which works in the cam groove, the front arm is pinned to the rear end of the actuating link.

The actuating link is in two parts, front and rear, which are connected by means of a sleeve. The rear part is forked and pinned to the cam lever, while the front part is pinned to a short vertical lever which is keyed to a short horizontal spindle. The latter passes inside the cradle cap and carries on its inner end a bevel wheel segment which engages with another bevel wheel segment feathered to the piston rod. Thus on elevating the gun the cam bearing on the roller revolves the cam lever, which

† Navy red material (compressed asbestos fibre composition) will be used for future manufacture

pulls upon the actuating link and short lever, rotating the cross spindle, bevel segments, piston rod and recoil valve, thereby decreasing the flow space between the ports in the latter and the piston, which is held fast by its feathers engaging in the grooves of the buffer cylinder. This increases the resistance set up in the buffer cylinder during recoil, thereby shortening the recoil of the gun. The recoil varies from 54 inches gun horizontal to 24 inches at 35° elevation.

The gear is adjusted by means of the sleeve which is free to revolve around the links and is secured by a keep pin. An arrow indicates the direction in which the sleeve should be turned in order to shorten the recoil.

The following table shows the relation between the elevation in degrees and the recoil in inches:—

Elevation of Gun in Degrees.	Nominal Recoil in Inches.
4° 50' (Dep.)	54.0
0°	54.0
5°	51.3
10°	47.7
15°	42.4
20°	36.2
25°	30.4
30°	27.2
35°	24.0

In the event of the cut-off gear becoming damaged, fittings are provided to enable the gear to be set by hand. These consist of a steel collar and a screw spindle with locking piece. The steel collar fits over the piston rod in front of the cradle cap and is formed with a flat to ensure it turning with the rod; a degree scale graduated from 0 to 35 is engraved around its circumference. The scale is read by a reader on a gunmetal bush which fits in the opening for the piston rod in the cradle cap and is screwed to it. The screw spindle with locking piece is carried in the cradle cap, in line with the bevel segment which is keyed to the piston rod and is secured by a split pin.

To set the gear, the piston rod is revolved by applying a spanner to the front end of the rod until the angle indicated by the reader on the bush approximates to the elevation at which the gun is to be fired. The piston rod is then prevented from revolving by turning the screw spindle, thus jamming the locking piece against the bevel segment on the piston rod. The gun should not be fired at any angle above which the gear is set.

RECUPERATOR.

(Plate XI.)

The gun is returned to the firing position after recoil by means of compressed air contained in the central cylinder. The

pressure of the air acts upon a floating piston which in turn acts through liquid upon the cylinder block through the holes in the retarding valve.

The recuperator liquid cylinder has its front end closed by a stuffing box which is screwed in against a fibre washer. The stuffing box packing consists of a M.B. supporting ring inserted from the front, over which fits a "U"-shaped rubber, in front of which is another M.B. supporting ring, the whole being held in position by a M.B. securing ring. In front of this is placed a ring of "Dicks" packing supported by a M.B. ring secured in position by a M.B. gland. The stuffing box is prevented from unscrewing by a locking plate and the gland by a locking pawl. Internally, near its front end, the cylinder is reduced in diameter to form a seating for a retarding valve, which fits loosely round the rod of the recuperator and is kept up to its work by a spiral spring, the rear end of which bears against the valve and the front end against a seating which in turn bears against the inner face of the stuffing box. The valve is provided with a coned head to fit tightly on its seating; four oblique holes are bored through the head to allow the liquid to pass from the central cylinder into the recuperator cylinder after recoil.

The recuperator piston rod is of steel; the front end is nutted to the cradle cap and its rear end is provided with a packed head. The packing is divided into two parts, front and rear. The front part consists of two U-shaped rubbers each with its supporting rings held in position by a collar screwed and pinned to the rod. To prevent an intensified pressure being put on the rear "U" rubber a steel stop ring, in halves, is placed in rear of the rear supporting ring. The rear part consists of a ring of "Lion" packing and supporting ring held in position by a strong spiral spring compressed by a cap screwed on the rear end of the piston head. The cap is prevented from unscrewing by a spring plunger contained within the piston head and fitting a squared opening in the cap. The piston rod is hollow throughout its length, its front end is closed by a small non-return valve in front of which it is threaded to take an adapter to which the pipe from the charging pump is connected when filling; when not in use the adapter recess is kept plugged. The plug and the front end of the piston rod are lettered "C." Two radial holes are bored through the rod in front of the packed head, these permit of the liquid entering the recuperator cylinder when forced down the hollow of the rod by the charging pump.

The recuperator cylinder has its rear end closed by a perforated dust cap. Fitted to the centre of the cap is a stud which carries a dermatine washer held in position by a dished brass disc and a nut. The washer prevents the ingress of dust but allows any liquid which may get over the piston head to get clear, otherwise the gun would not return fully to the firing position after recoil. The holes in the cap also prevent a vacuum forming in the cylinder in rear of the rod. A steel strap screwed to the recuperator cylinder secures the dust cap in position.

AIR RESERVOIR.

(Plate XI.)

The central cylinder forms an air reservoir in which works a floating piston.

It consists of a hollow steel piston with packing and a tail rod which works through a gland at the front end of the central cylinder. The piston packing is in two parts, front and rear. The front part consists of a "U"-shaped rubber with supporting ring held in position by a securing nut which is prevented from unscrewing by a locking plate. The rear part consists of a ring of "Lion" packing with supporting ring held in position by a strong spiral spring compressed by a nut screwed on the rear end of the piston head and secured by a split pin. In future manufacture the spiral spring will be omitted.

The tail rod is of tubular steel; it is secured to the front of the piston by a screwed collar held by a locking plate. An undercut groove is formed near its front end to take a copper ring which acts as a tell-tale; the exposure of the ring indicates that the supply of liquid in the recuperator is low and should be replenished. The front end of the tail rod passes out through the cradle cap and is enclosed in a steel cover screwed to the cap and riveted in.

The front end of the central cylinder is closed by a steel stuffing box which is screwed in on a fibre washer to make a tight joint. The packing consists of a M.B. supporting ring inserted from the front over which fits a U-shaped rubber in front of which is another M.B. supporting ring, the whole being held in position by a M.B. securing ring. In front of this is placed a ring of "Dicks" packing supported by a M.B. extension ring, the whole being held in position by a M.B. gland. The stuffing box is prevented from unscrewing by a locking plate and the gland by a locking pawl.

An opening is bored through the cylinder block near the front end of the central cylinder; this forms a communicating channel between the central and recuperator cylinders.

The rear end of the central cylinder is solid; the cylinder block at this point is formed with an extension which is screw threaded to take a castellated nut by means of which the gun lug is secured to the block. Two openings are bored in the extension, one above the other; the lower lettered "M," is bored through to the central cylinder and is closed by the stem of a small valve on the outer end of which is formed flats to take a spanner. Leakage past the valve is prevented by a ring of asbestos packing with neck rings and a gland. The upper opening lettered "L" which is in communication with the lower, is screw threaded at its outer end to take an adapter to which the pipe of the charging pump is attached; when not in use it is kept plugged.

ACTION OF BUFFER AND RECUPERATOR.

For use the buffer is filled with mineral oil. Quantity required about 24-pints.

The recuperator is filled with mineral oil (quantity required, 27-pints) and charged with air to a pressure of 600-lbs. per square inch. For details of charging see pages 45 to 49.

Before firing, the operation of elevating the gun automatically prepares the buffer for the correct length of recoil.

On firing, the gun recoils along the top of the cradle, taking with it the buffer and recuperator cylinders, the piston rods being nitted to the cradle cap, remain stationary. As the buffer is drawn back the liquid passes through the ports in the recoil valve and piston from front to rear. At the commencement of recoil the ports in the recoil valve are opposite the ports in the piston, thus allowing for the free flow of the liquid, but as the recoil proceeds the piston is caused to revolve on the piston rod by the grooves in the buffer cylinder, thus causing the ports to be gradually closed, which graduates the pressure and absorbs the energy of the recoil of the gun.

The packed head of the recuperator forces the liquid from the recuperator cylinder into the central cylinder, the retarding valve being forced off its seating for this purpose; the liquid acting on the front face of the floating piston forces the latter to the rear, thus raising the pressure in the air reservoir.

On the recoil ceasing, the retarding valve is closed by the action of its spring and the pressure of the liquid, the air expands, and, acting on the rear face of the floating piston, forces the liquid back through the holes in the retarding valve into the recuperator cylinder, thus returning the gun into the firing position. The latter is prevented from running up with violence by the slowness with which the liquid is forced through the holes in the retarding valve and also by the control plunger, which latter, as the gun nears the firing position, enters its chamber and displaces the liquid therein, first over the tapering flat on the plunger and also past the adjustable valve through the side channel, but finally through the latter means only.

The working recoil is 54-inches, gun horizontal, metal to metal 56-inches.

SIGHTING.

The carriage is provided with the following sighting arrangements:—

Carrier, No. 7 dial sight, No. 9	}	Left side.
Sight, dial, No. 7		
Clinometer, sight		
Sight, dial, No. 1		Right side.

CARRIER, No. 7 DIAL SIGHT, No. 9.

(Plate XII.)

The carrier consists of the following principal parts:—

- Supporting bracket.
- Elevating arc bracket.
- Sight socket bracket.
- Elevating arc.
- Cross-levelling gear.

The supporting bracket is pivoted about its centre to the left cradle trunnion. It is shaped at its front end to receive a projection on the cradle, by means of which the carrier is made to pass through the same angles of elevation as the gun. Two adjusting screws are also provided for adjusting the carrier for elevation, the screws being fixed as required by locking plates. The supporting bracket is provided with a degree scale, graduated in degrees from 5 degrees depression to 35 degrees elevation, for use as an elevation indicator; it is read by a pointer fixed to the left side piece of the carriage.

The elevating arc bracket is hinged to the rear end of the supporting bracket in such a manner as to allow it to be rocked in a plane at right angles to the axis of the piece by means of the cross-levelling gear which is interposed between the lower ends of the brackets. By this arrangement the carrier can be adjusted to compensate for difference in level of the carriage wheels. A spirit level is attached to the elevating arc bracket and indicates when the carrier is level transversely.

The elevating arc works in the elevating arc bracket. Teeth are cut on the rear face of the arc which engage a worm mounted in the bracket; the worm is actuated through bevel wheels by a hand-wheel. An elevation scale-plate graduated for 8 c.r.h. shell from 0 to 35 degrees, in multiples of 5 minutes is provided.

The scale-plate is removable and is attached to the elevating arc. The degree scale is read by a bar which is pivoted at one end to the elevating arc bracket, the other end being provided with an index which coincides with a muzzle velocity scale. The bar can be set and fixed at the required M.V. by means of a worm spindle actuated by a cranked key; the key for the isolating valve can be used for this purpose; the lower edge of the bar is waved to distinguish it from the reading edge. The M.V. scale is graduated up to 150 f.s. in multiples of 10 f.s. above and below normal M.V. By this arrangement variations in muzzle velocity can be compensated for at all angles of elevation.

(See para. "Use of Carrier, No. 7 Dial Sight, No. 9," page 38.)

The sight socket bracket is secured to the top of the elevating arc. It is shaped to receive the No. 7 dial sight, which is held in position by a plunger and spring. The bracket is furnished with a plate to which the sight clinometer is attached and an adjustable stop screw. Two adjusting screws are also provided for adjusting the dial sight for line.

The sight is housed when travelling by means of a pivot block pinned to the bottom of the elevating arc, which in turn is pinned to the arm of the housing gear. The arm is pivoted to a bracket riveted to the carriage.

Note.—Care must be taken to disconnect the housing gear before the elevating gear is operated.

To compensate for drift the carrier is set at a permanent angle of 2 degrees 20 minutes to the left.

CLINOMETER, SIGHT.

The sight clinometer is used to allow for the "angle of sight," it admits of 20 degrees elevation or depression and is so constructed that it can be readily attached to its carrying bracket. The *Mark I* sight clinometer consists principally of a cradle with a worm spindle and a toothed arc with a spirit level. The cradle is fitted on the underside with spring clips for the purpose of attaching the sight clinometer to its carrying bracket, the clips are actuated by means of a spiral spring placed horizontally between them and the top of the cradle is provided with radial grooves in which the toothed arc slides. The worm spindle passes through the centre of the cradle and is supported at each end by movable bearings, one of which is pivoted to the cradle and the other is free to slide in grooves for a limited distance so that the worm on the spindle may be disengaged from the teeth in the arc when necessary for quick setting. The worm is kept up to its work by a flat spring, which is attached at one end to the cradle, the other end taking a bearing on the underside of the spindle. An adjustable micrometer collar, graduated to read minutes in multiples of five, is attached to each end of the spindle. The arc consists of a toothed segment with a spirit level above, fitted with "bubble spirit glass 'L'", it slides in the grooves on the cradle and the teeth engage with the worm on the spindle. An adjustable reader is attached to the arc for reading the elevation and depression scales on the cradle.

The *Mark II* sight clinometer is generally similar to the *Mark I*, from which it differs in minor details in order to facilitate manufacture.

The *Mark II** sight clinometer is the *Mark II* converted by the replacement of broken "L" bubbles by the † "bubble spirit glass 'P'". The letter "R" is painted in red on the cradle, immediately below the zero mark of the degree scale, signifying that the bubble is radium treated.

The *Mark III* sight clinometer is generally similar to the *Mark I*, except that it is fitted with the † "bubble spirit glass 'P'" and for the purpose of readily distinguishing it from the *Mark I*, the letter "R" is painted in red on the cradle. In the case of *Mark I* sight clinometers which have had broken "L" bubbles replaced locally by "P" bubbles, the *Mark* is advanced to *Mark III*, and the letter "R" painted in red on the cradle, signifying radium treated.

The *Mark IV* sight clinometer is generally similar to the *Mark III*, from which it differs in the design of clip attachment. The clip attachment is constructed so that the spiral spring is mounted in a perpendicular position and cannot possibly become detached without the clips being released by hand. The great advantage this method of spring attachment possesses over the horizontal method is that the sight clinometer is not apt to jump out of its carrying bracket when the gun is fired, as often occurs with the *Marks I to III* sight clinometer.

† In future all marks of sight clinometer will be fitted with the "L" bubble.

SIGHT, DIAL, No. 7.

(Plates XIII and XIV.)

The No. 7 dial sight is employed for both direct and indirect laying. The upper part can be revolved horizontally through a complete circle independently of the eye-piece, thereby allowing the layer to see an object in any direction without moving the position of his eye. Owing to the height of the sight the layer can lay on objects directly behind him, the line of sight being above his head.

Mark III.—The optical arrangements are so designed that an object viewed through the sight is always seen erect. They consist of:—

F, the *upper prism*, which is mounted in the upper portion of the sight. Its face can be turned in any direction with reference to the eyepiece K, the angle between the two being indicated on the dial plate A by means of a reader on the bracket N.

G, the *centre prism*, which, by means of bevel gearing, is made to revolve at half the speed of the upper prism F; this arrangement ensures the object layed on always appearing erect.

H, a double reflecting roof prism.

J, the object glass.

K, the eyepiece, with two eye lenses.

M, a glass diaphragm, upon which are engraved vertical and horizontal lines, with gaps near their centres; a radium dot is placed just below the optical centre on the vertical graticule and is for use at night.

A glass window in the eyepiece allows the lines to be illuminated at night.

The magnification of the system is 4 diameters and the field of view is 10° . There are no arrangements for focussing the sight.

The principal mechanical parts are the following:—

B, the *supporting pillar*, in which are suitably mounted the eyepiece K, fitted with a dermatine eyeguard, the lower prism H and the object glass J. The "plug, supporting pillar" V is screwed in to its lower end and on it is a castellated nut, which is prevented from unscrewing by a split pin. Near the upper end of the supporting pillar is a coned seating W, which fits accurately on to a coned bearing on the carrier.

The projection X, which fits into a slot in the carrier, prevents the sight revolving and is also the means by which the dial sight is adjusted for line, when in use with carriers fitted with dial sight adjusting screws and lock nuts.

C, the worm-wheel bracket, is firmly secured to the supporting pillar B. In it is mounted the slow motion traversing gear, which consists principally of a worm spindle S, the worm on which engages with the worm-wheel D. On either end of the spindle is mounted a milled head and an adjustable micrometer scale drum. The drums are graduated in opposite directions in divisions of 10 minutes, right angles being denoted by white lines on a black background and left angles by black lines on a brass background. For future manufacture the distinctive marking will be omitted, the graduations being filled in with black wax on a bright metal background, right angles being indicated by the letter "R" and left angles by the letter "L." See Plate XIV. The drums can be adjusted by loosening the caps inside the milled heads and turning them independently of the milled heads. The readers for the drums are on the worm-wheel bracket. Each turn of the worm spindle moves the upper part of the sight through 5° . The worm spindle is mounted in an eccentric, which when turned by raising a lever near the left drum throws the worm out of gear with the worm-wheel. This enables the upper part of the sight to be revolved rapidly.

The rear surface and four screws are for the attachment of the upper portion of the deflection bracket of the No. 1 special and Nos. 2, 4 and 5 dial sight carriers, but in future manufacture carriers will not be provided with deflection brackets and all deflection angles will be applied through the dial sight.

D, the worm-wheel, has teeth cut on its lower portion, which engage with the worm spindle S. It extends upwards and is firmly secured to the upper prism holder E, and the dial plate A by screws, &c.

Y, the centre prism holder, fits accurately in the supporting pillar B. To it is attached the prism mount P, in which the centre prism G is firmly held.

The prism holder is free to revolve and is forced to do so at half the speed of the upper prism holder E, by means of three bevel wheels. The axis of the vertical bevel wheel Z is formed on a projection from the prism holder. This wheel engages with the lower bevel wheel Z^1 , which is fixed to the supporting pillar and also with the upper bevel wheel Z^2 , which is fixed to the upper part of the sight. When the upper part of the sight is revolved the axis of the centre bevel wheel and consequently the central prism, are forced to revolve at half the speed of the upper part of the sight.

E, the upper prism holder, as previously mentioned, is rigidly attached to the dial plate and worm-wheel. In it are suitably mounted the upper prism and a glass window.

A Mark I diaphragm is hinged to the case of the upper prism holder by means of which the focus and parallax at short distances can be corrected without any appreciable loss of light.

The diaphragm, which is fitted with a shutter, is only for use at short distances of approximately 20 yards or under.

A spring is provided which retains the diaphragm in position when closed.

In the centre of the diaphragm is a hole .25 inch diameter and in the shutter one of .125 inch diameter.

If the object to be viewed is only a few feet away, the shutter is to be used and the object viewed through the small hole.

When the dial sight is used at a distance of more than 20 yards, the diaphragm is to be lowered from the front of the window.

The *Mark II* diaphragm differs from the *Mark I* principally in the following particulars:—

The hinge pin is of strengthened pattern.

The shutter can be operated from the outside, instead of it being necessary to lower the diaphragm.

The spring retaining the diaphragm is of an improved design and also retains the shutter.

To enable the line of sight through the upper prism to be elevated or depressed, a small toothed arc is attached to the mount of the prism. The teeth of this arc engage with a worm spindle R. At the top of this spindle are mounted a milled head and adjustable drum, engraved with a zero mark. The reader is engraved on the prism holder; 17° elevation or depression can be given. The letters "E" and "D" are engraved against each numbered graduation to denote Elevation and Depression, respectively.

A crosshead with open sights (or view finder) is mounted on the right side of the upper prism holder. Its movement is regulated by that of the upper prism, but as the latter has a reflecting surface the former has to move twice as quickly. This is arranged for by a toothed wheel on the prism mount gearing with a toothed wheel, having only half the number of teeth, on the pivot of the crosshead with open sights.

Engraved on the under portion of the crosshead is a zero mark, indicated by an arrow on the upper prism holder.

A, the *dial plate*, as previously mentioned, is firmly fixed to the worm-wheel and upper prism holder. The dial plate is cast with two lug pieces on it to prevent any play between the dial plate and the case upper prism holder. Two scales, each reading from 0 to 180 in single degrees, are engraved round the dial plate, *right* angles being denoted by white lines on a black background and *left* angles by black lines on a brass background. For future manufacture the distinctive marking will be omitted, the graduations being filled in with black wax on a bright metal background, *right* graduations being indicated by the letter "R," the *left* by the letter "L." The graduations are read by a reader on the reader bracket N. This reader can be adjusted by loosening

two screws in its rear surface and moving it to one side. The amount of adjustment that can be thus obtained is approximately $1\frac{1}{2}$ degrees on either side of zero, but instructions will shortly be announced in List of Changes for this adjustment to be increased to 2 degrees for existing sights, whilst sights of future manufacture will have an adjustment of $2\frac{1}{2}$ degrees each way.

Mark II.—The *Mark II* sight differs from the *Mark III* in the following particulars:—

- (1) The dial plate is not cast with two lug pieces on it.
- (2) The slope of the dial plate is steeper, which causes the reader plate to be slightly lower.
- (3) The boss on the top of the dial plate is slightly smaller in diameter, necessitating a smaller clamping collar and lead lining.
- (4) The vertical scale graduations on the upper prism holder crosshead and the micrometer head, excepting the zero and index marks, are omitted.

Mark I.—The *Mark I* sight differs from the *Mark II* in the following particulars:—

One of the milled heads on the worm spindle is smaller.

A vertical scale, with graduations to 15° elevation and depression, is fixed to the upper prism holder and the micrometer scale drum is graduated in intervals of 10 minutes.

Certain internal parts are of steel instead of bronze.

Mark I and II sights are brought up to *Mark III* type when passing through Woolwich for repair.

SIGHT, DIAL, No 1.

(Plate XIVa.)

The *Marks I** and *II* dial sights consist of a circular carrying plate with degree scale ring, a crosshead and pin and a sight plate with pointer. The carrying plate is hinged at the centre to the crosshead and the crosshead is hinged transversely to the crosshead pin. This arrangement admits of an adjustment right or left to compensate for any difference that may occur in level of the wheels and for elevation or depression being given to the plate and sight. The degree scale ring is fixed to the periphery of the carrying plate by screws; it is marked in degrees (white on black for right side and black on brass for left), 180 on each side of zero, the required angle being read by means of a pointer fixed to the rear end of the sight plate. Should it be found, by examination, that when the sight line and axis of the gun are parallel, zero is *not* indicated, the pointer is so formed as to admit of the required adjustment being made. The sight plate is pivoted to the centre of the carrying plate and jointed near its centre; the joint pin is provided with a thumb nut for clamping

the plate in the extended or folded position; the plate is fitted with an acorn-pointed fore-sight at the front end and notched to form a hind-sight at the rear end. A clamping screw is provided to fix the sight plate at the required angle. The sight is fixed to the bracket by the crosshead pin, which fits into a corresponding socket in the supporting pillar and is secured by a keep pin.

INSTRUCTIONS FOR TESTING AND ADJUSTING CARRIER, No. 7 DIAL SIGHT, No. 9.

Sight Test.

The field clinometer, sight clinometer and elevation indicator should be tested daily and after prolonged firing. The alignment tests should be carried out as often as possible.

Any adjustment to optical instruments must be carried out by a qualified artificer.

Test 1.—To test and adjust the field clinometer.

Set the clinometer at zero; place it on the clinometer plane and elevate or depress the gun until the bubble is in the centre of its run; then turn the clinometer end for end.

If the bubble is still in the centre of its run the clinometer is in adjustment.

If the bubble is not in the centre of its run, bring it so by moving the slider, or, if necessary, the arm and slider.

One-half of the nett reading is the index error of the clinometer.

If the bubble cannot be brought to the centre of its run by this method, the error of the clinometer may be determined by comparison with a clinometer of known error.

To eliminate an error, the clinometer must be adjusted by a qualified artificer.

Test 2.—To test and adjust the sight clinometer.

With the sight bracket horizontal and the sight clinometer reading zero, the bubble of the sight clinometer should be in the centre of its run.

Place the sight clinometer set at zero in its bracket and bring the bubble to the centre of its run by the elevating handwheel. Reverse the clinometer end for end; the bubble should still be in the centre of its run.

If the bubble is not in the centre, bring it so by turning the micrometer head. Note the reading and set the micrometer scales to half this reading. Bring the bubble to the centre of its run by the elevating handwheel. Slacken the nuts securing the micrometer scales and the screws securing the reader of the degree scale; shift the micrometer scales and reader to zero and reclamp.

Test 3.—To test and adjust the elevation indicator.

With the sight clinometer reading zero and the bubble in the centre of its run, the elevation indicator should read the eleva-

tion at which the gun is laid. The muzzle velocity pointer must be normal.

Place a shell in the chamber to take up play in the elevating gear.

Cross-level the sight, set the sight clinometer at zero and set the elevation indicator at 8° .

Lay the gun at 8° elevation with a clinometer; bring the bubble of the sight clinometer to the centre of its run by the adjusting screws at the front end of the supporting bracket.

The locking plates of the screws must first be removed and replaced after adjustment.

Alignment Tests.

Before beginning the tests the following preparations should be made:—

Place the carriage on a firm platform, manipulate it until it is level transversely.

Select a well-defined object at least 1,500 yards distant on which to lay.

If this distant object cannot be found, set up the target testing sights (*see* Plate XV) about 50 yards in front of the gun at right angles to the axis of the bore.

If the carriage is not level transversely, the top of the dial sight carrier and the target testing sights should be sloped to the same angle as the carriage.

Fix the cross wires at the muzzle of the gun.

Set the elevation indicator and the cowl of the dial sight at zero; set the dial plate and the micrometer scales of the dial sight at zero and the muzzle velocity pointer at normal.

Test 4.—To test and adjust the dial sight for line.

Note.—In practice tests 4 and 5 are carried out simultaneously.

The line of sight through the dial sight should be parallel to the axis of the bore as regards line.

Place the No. 7 dial sight in position. Lay the bore on the distant object for line by the elevating handwheel and the traversing gear, using the intersection of the cross wires as a fore sight and the axial-vent as a hind sight. The line of sight through the dial sight should be on the distant object. When using the target testing sights, lay the bore on point B; the dial sight should be on point D.

If the dial sight is not in alignment, bring it so by the adjusting screws on the sight carrier, taking care that the locking nuts are first slackened and tightened after adjustment.

The No. 1 dial sight should also be on the distant object or on point "S" of target when set at zero. If it is not so, align the sight plate on the distant object or point "S" of target and clamp it, slacken the clamping screw at the rear end of the sight

plate and bring the pointer to zero, then tighten up the clamping screw.

Test 5.—To test and adjust the No. 7 dial sight for elevation.

The line of sight through the dial sight should be parallel to the axis of the bore as regards elevation when the elevation indicator is at zero.

Lay the bore on the distant object for elevation by the elevating handwheel. The line of sight through the dial sight should be on the distant object. When using the target testing sights lay the bore on point B; the dial sight should be on point D.

If the dial sight is not in alignment, revolve the milled head at the top of the sight until the line of sight is correct, slacken the nut securing the micrometer collar, revolve the latter to zero and reclamp.

Note.—After adjusting the micrometer collar of the cowl of the dial sight the arrow on the view finder will not be opposite zero; if confusion is likely to arise, this arrow should be erased and a new one scribed opposite the zero mark.

Note.—*To Ascertain Droop Correction.*—Place field clinometer at zero on clinometer plane at breech end and bring bubble central by elevating gear, move field clinometer to clinometer plane on muzzle, and level by moving the slider. Droop is then read on arm.

USE OF THE CARRIER, NO. 7 DIAL SIGHT, NO. 9.

The gain or loss of M.V. with full and reduced charges is calculated as in the specimen calibration form given in the Range Table.

With full charges and 8-c.r.h. projectiles the M.V. reader is set to the figure for gain or loss of M.V.

With reduced charges (6-lbs. 6-ozs.) and 8-c.r.h. projectiles the actual gain or loss of M.V. with this charge must be multiplied by the factor 1.13 and the M.V. reader set at the figure thus obtained.

With full charges and 2-c.r.h. projectiles the actual gain or loss of M.V. must be multiplied by 0.85.

With the 6-lb. 6-oz. charge and 2-c.r.h. projectiles, the actual gain or loss of M.V. must be multiplied by 0.95.

Note.—It is necessary to calibrate the gun with each charge and projectile in use as there is no known connection between the gain or loss of M.V. in each case.

PART IV.

LIMBER, B.L. 60-pr. CARRIAGE, MARK IA.*(Plates IV.a. and IV.b.)*

The limber consists of a steel frame, coupling arrangements, two steel boxes, a 1st class axletree, draught fittings, and two field wheels.

The frame consists principally of four futchels (two inner and two outer) connected at the rear to the axletree by flanges, at the front by connecting plates and strengthened by diagonal stays. A pintle with pin is fitted to the centre futchels above the axletree. The arrangement for coupling the carriage to the limber consists of a coupling block and a draught bar. The front end of the coupling block is supported by the body of the pintle, the stem passing through a link formed at its front end; the rear end is box shaped to receive the trail eye of the carriage. The block is coupled to the axletree by a radial draught bar, which is pivoted at the front end to a steel strap placed about the centre of the axletree, and is connected at the rear end to the block by a bolt. The trail eye of the carriage is secured to the block by a loop-headed connecting pin attached to a fixed key by a chain. To lock the pin, an opening in the head must be placed over the key and the pin rotated. Two rope handles are attached to the coupling block to facilitate the lowering of the block when the gun is unlimbered. The plates which connect the futchels at the front, and serve the purpose of a splinter bar, are fitted with a pole socket, draught hooks and outriggers with stays and hooks for four-horse draught. Draught joints with coupling pins are also fitted for the attachment of an engine draught connector. To the rear of the pole socket two plates are fixed above and below the inner futchels to support a No. 17 Mark III draught pole, which may be used (instead of No. 19) on an emergency and which should be further supported by suitable packing placed around the pole socket. Brackets are fitted to the outer futchels to facilitate the raising of the limber by a lifting jack.

Two steel boxes for carrying spanners, spare parts and small stores are fitted, one each side; the lids open from the top and are fastened at the rear by hasps and turnbuckles and provided with padlocks.

A wire net receptacle is fixed below the boxes for carrying the drag ropes and lashings.

A board with clips for carrying two rifles in covers is attached to the frame in front of the boxes.

The boxes are fitted to carry the various stores shown on pages 41 to 43 and packing Diagrams C and D.

The fittings for draught consist of a No. 19 draught pole, with four No. 12 swingletrees and a No. 4 pole bar for horse draught; a connector, No. 3, is provided for engine draught. The pole and bar are for use with the R.A. pole draught breast harness. The pole is 12-feet 2·8-inches long (over all); the front end is protected by steel wrapping plates; a U-shaped tug is passed through the pole from the under side and secured by a nut on the top. The tug forms a stop for the pole bar and its position from the point of the pole may be varied from 26½-inches to 14½-inches, in distances of 3 inches, according to requirements. The front end of the pole is prepared for two stop bolts, which are only required when bullock draught is used. The No. 4 pole bar is 4-feet 3½-inches in length and is fitted at the centre with a circular loop, which is formed to pass over the front end of the pole and butt against the tug. Two links are fitted on each side of the loop, by means of which the bar is attached to the neck piece of the harness. The swingletrees are 2-feet 5·8-inches long. The engine draught connector is V-shaped; a coupling bolt (with a volute spring) passes through an opening in the apex and the forked ends are formed with lugs for attachment to the draught joints on the limber.

A yoke and chains for bullock draught can be used with the limber as required. The chains will be attached to the draught joints of the splinter bar by the hooks or first link, as may be found most convenient.

The axletree, which is 1st Class "B" No. 4, is of tubular steel and is fixed by flanges to the futchels. The linch pin and adjusting collar are the same as for the carriage and the outer flanges are provided with dust excluders, which are similar to those on the carriage.

The wheels are 1st class "B" pattern No. 10. They are 5-feet in diameter, having 14 spokes, 7 felloes, 2 M.B. flanges, a removable P.B. pipe-box and a 6-inch steel ring tire with rounded edges. The pipe-box passes through the flanges and is connected to the inner one by a bolt. Its inner end is shaped to fit into the dust excluder and its outer end is screwed to receive a bearing for the drag-washer and a dust cap, the latter being secured to the bearing by two pins. The flanges are bolted together by 14 nave bolts, which pass through the feet of the spokes and are nutted up back and front alternately.

The tire is secured to the felloes by 14 tire bolts, 2 to each felloe, which fit into countersunk holes on the outside and are nutted up on the bosom of the wheel.

The limber is fitted to carry various stores as shown at pages 41 to 43, also on Packing Diagrams B to D.

DIAGRAM OF PACKING B.L. 60-PB, CARRIAGE MARK IV.

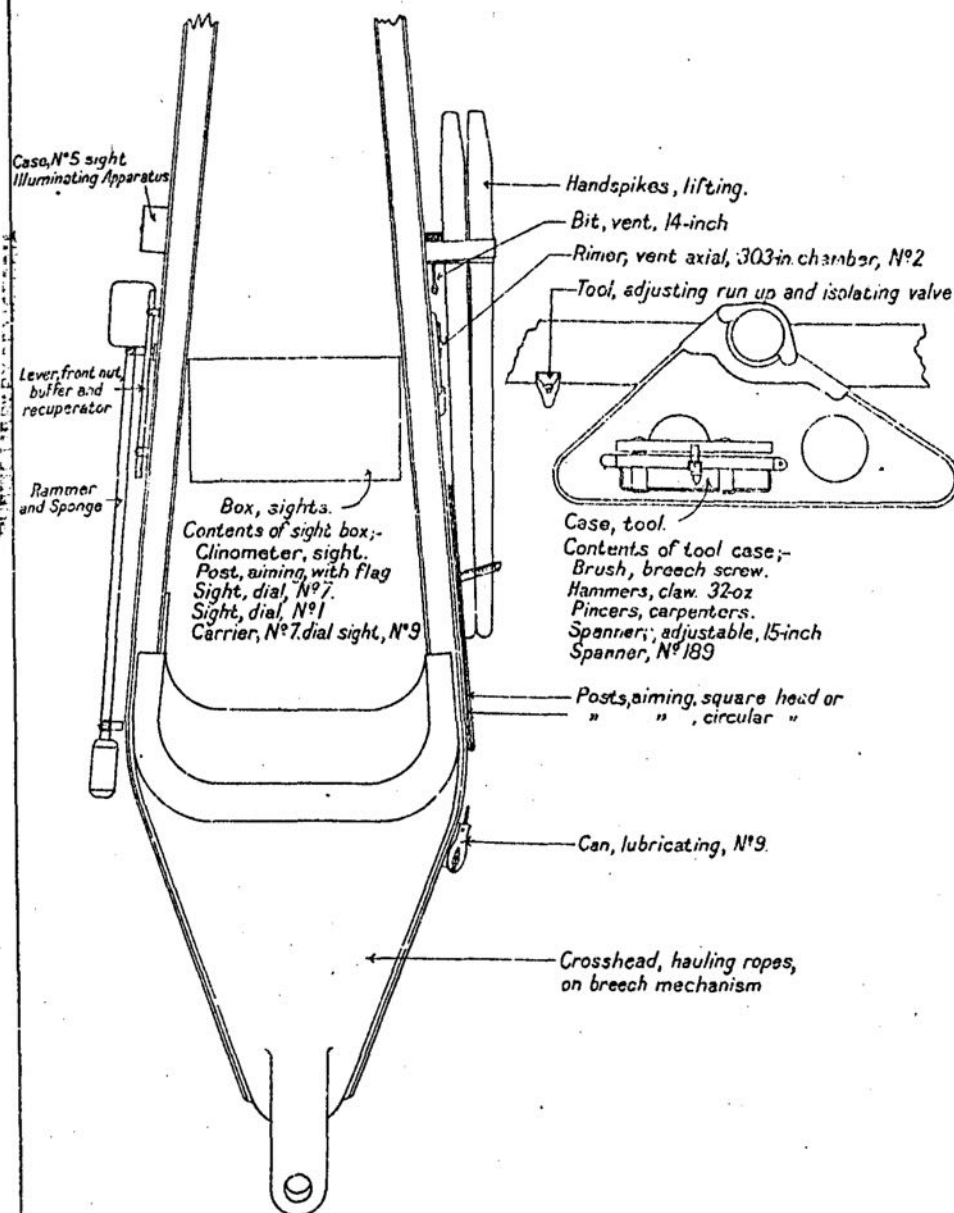
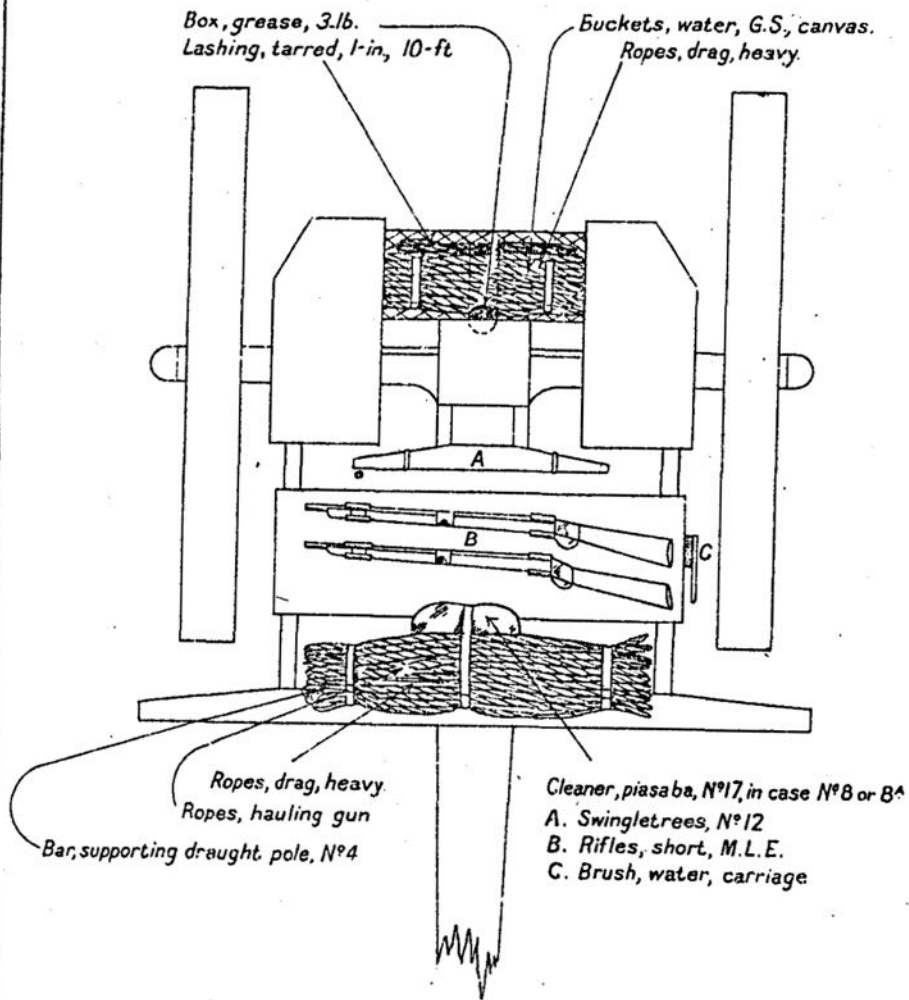
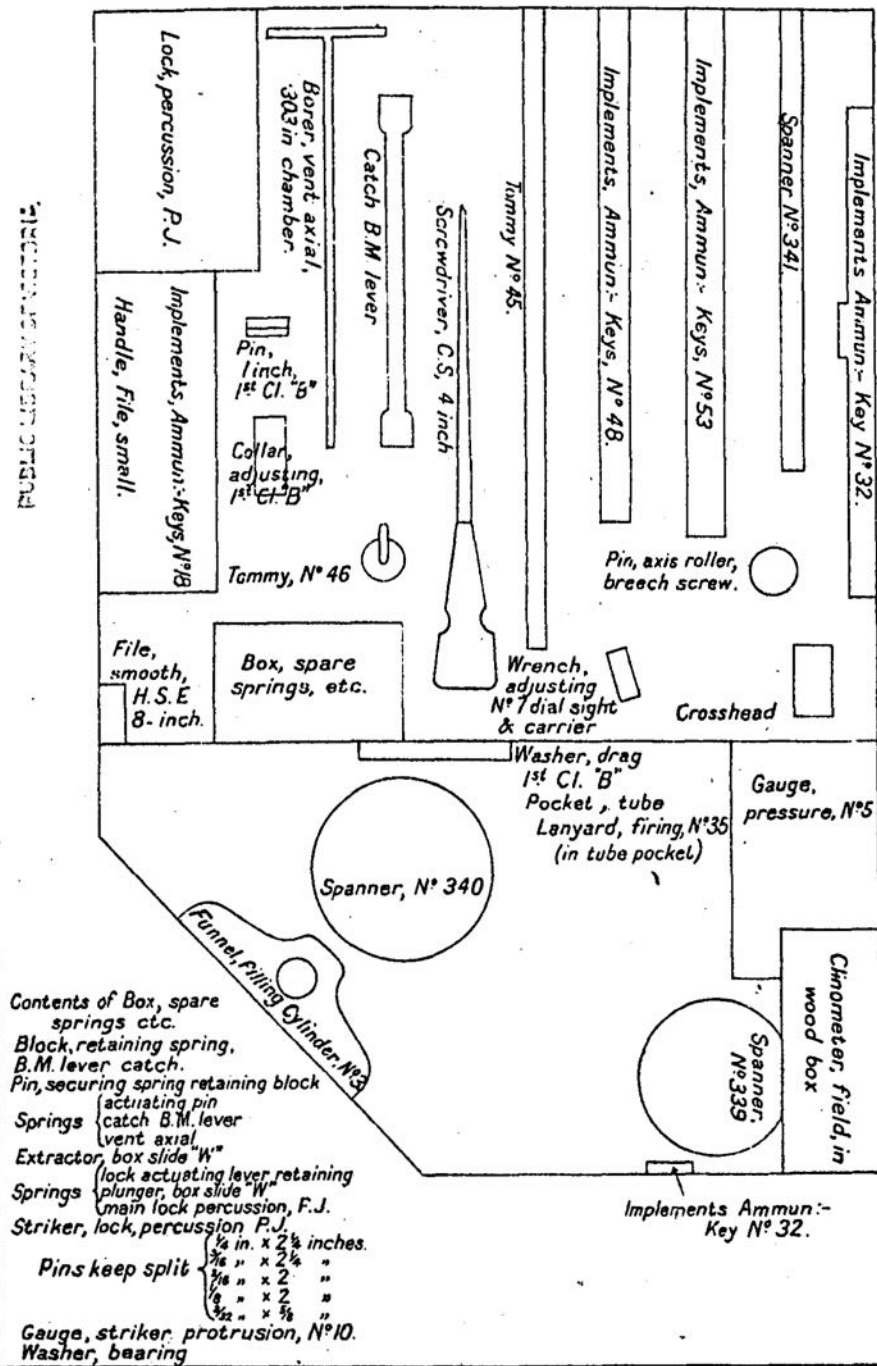


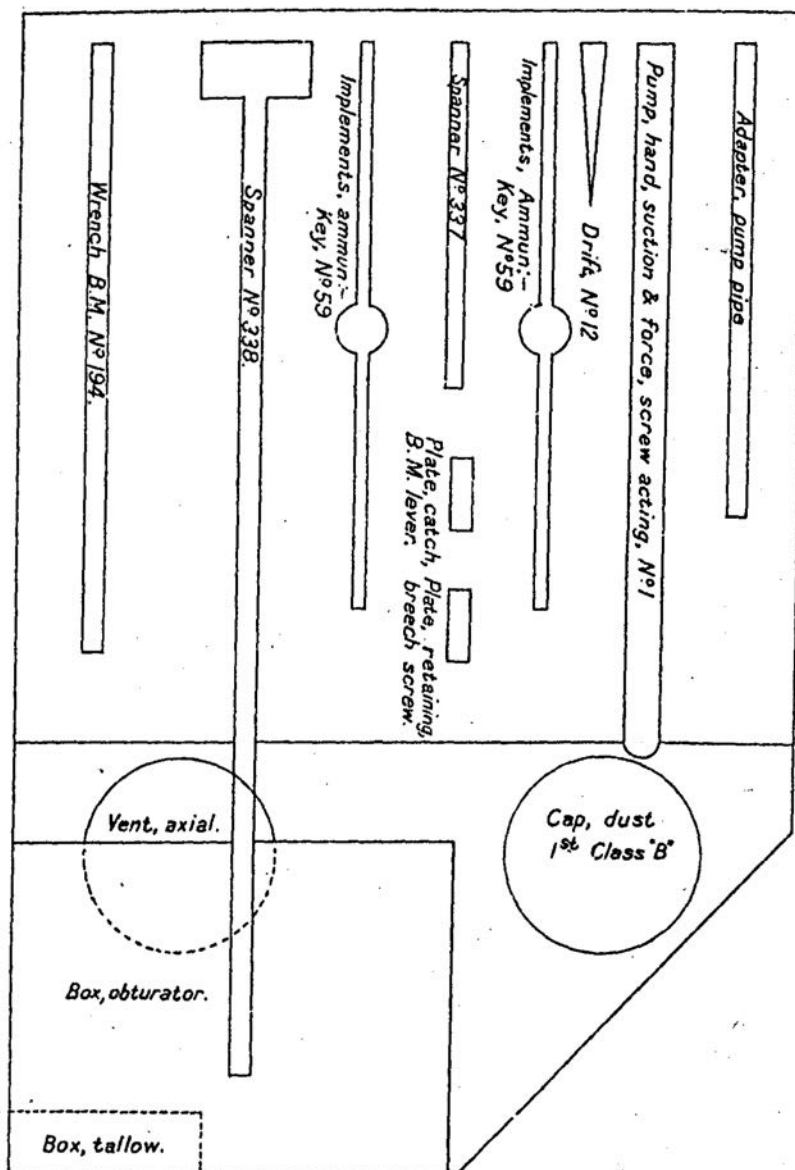
DIAGRAM OF PACKING.
B.L. 60-P^R LIMBER, MARK I.A



BOX, LIMBER, B.L. 60-P^R CARRIAGE, "OFF".**LIMBER, MARK IA.**

BOX, LIMBER, B.L. 60-PR CARRIAGE, "NEAR"

LIMBER, MARK IA.



LIST OF STORES.

CARRIAGE.

Articles.	No.	Where carried.
Apparatus, illuminating sights, No. 5	1	In case, on left side of trail.
Bit, vent, 14-inch	1	On right side of trail.
Box, sight	1	In trail.
Brush, breech screw	1	In tool case, on right side of carriage body.
Can, lubricating, No. 9	1	On right side of trail.
Cap, sponge, No. 9	1	On rammer and sponge.
Carrier, No. 7 dial sight, No. 9 ...	1	In sight box, in trail.
Case, tool	1	On right side of carriage body.
Clinometer, sight	1	In sight box, in trail.
Crosshead, hauling ropes	1	On breech.
Hammer, claw, 32-oz....	1	In tool case, on right side of carriage body.
Handspikes, lifting	2	On right side of trail.
Lever, front nuts, buffer and recuperator	1	On left side of trail.
Pincers, carpenter's pair	1	In tool case, on right side of carriage body.
Posts, aiming { with flag	1	In sight box, in trail.
{ circular head	1	} On right side of trail.
{ square head	1	
Rammer and sponge	1	On left side of trail.
Rimer, vent axial, 303-inch chamber, No. 2	1	In pocket, on right side of trail.
Sight, dial, No. 7	1	} In sight box, in trail.
No. 1	1	
Spanner, adjustable, 15-inch... ..	1	} In tool case, on right side of carriage body.
No. 189	1	
Tool, adjusting, run-up and isolating valve	1	In pocket, on right side of cradle.

CARRIAGE LIMBER.

Articles.	No.	Where carried.
Adapter, pump pipe	1	In "near" limber box.
Bar, supporting draught pole, No. 4 (spare)	1	On top of futchels, front of limber.
Borer, vent axial, 303 inch chamber	1 (a)	In "off" limber box.
Box { grease, 3-lbs.	1	Under limber.
{ obturator	1	In "near" limber box.
{ spare springs, keep pins, washers or insulators, No. 1.	1	In "off" limber box.
Brush, water, carriage	1	In pocket, near side of limber.
Buckets, water, G.S. canvas	2	In wire net receptacle.
Cap, dust, 1st class "B" capped wheel. (spare)	1 (a)	In "near" limber box.
Case, No. 8 or 8A cleaner	1	On "cleaner piassaba No. 17."

(a) For each section.

Carriage Limber—continued.

Articles.	No.	Where carried.
Cleaner, piasaba, No. 17	1	On top of futchels, front of limber.
Clinometer, field, in wood box ...	1	} In "off" limber box.
Collar, adjusting, 1st class "B" capped wheel ... (spare)	1 (a)	
Covers, rifle	2	On rifles.
Discs, adjusting obturator (spare)	2	In obturator box, in "near" limber box.
Drift, No. 12	1	In "near" limber box.
File, smooth, H.S.E., 8-inch ...	1	} In "off" limber box.
Funnel, filling cylinder, No. 3 ...	1	
Gauge, pressure, No. 5	1	In "box, spare springs, etc.," in "off" limber box.
Gauge, striker protusion, No. 10 ...	1	
Handle, file	1	In "off" limber box.
Implements, ammunition :—		
Keys, No. 18	2	} In "off" limber box.
" " 32	2	
" " 48	2	
" " 53	2	
" " 59	2	In "near" limber box.
Lanyard, firing, No. 35	2	In tube pocket, in "off" limber box.
Lashing, tarred, 1-inch, 10 feet ...	4	In wire net receptacle.
Obturator	2	In obturator box, in "near" limber box.
Ordnance, B L. :—		
Block, retaining spring, B.M. lever catch (spare)	1 (a)	In "box, spare springs, etc.," in "off" limber box.
Catch, B.M. lever	1 (a)	} In "off" limber box.
Crosshead	1 (a)	
Extractor, box, slide, "W" ...	1	In "box, spare springs, etc.," in "off" limber box.
Lock, percussion, "P.J." (spare)	1	In "off" limber box.
Pin { axis, roller, breech screw (spare)	1 (a)	In "off" limber box.
	1 (a)	In "box, spare springs, etc.," in "off" limber box.
Plate { catch, B.M. lever " retaining breech screw (spare)	1 (a)	} In "near" limber box.
	1 (a)	
Springs { actuating pin ... "	1	} In "box, spare springs, etc.," in "off" limber box.
	1	
	1	
	1	
Striker, lock, percussion, "P.J." (spare)	1	In "near" limber box.
	1	
Vent, axial	1	In "box, spare springs, etc.," in "off" limber box.
Washer, bearing	1	

(a) For each section.

Carriage Limber—continued.

Articles.	No.	Where carried.
Pins, keep, split :—		
$\frac{1}{4}$ -inch \times $2\frac{1}{4}$ -inch ... (spare)	1	In "box, spare springs, etc.," in "off" limber box.
$\frac{3}{16}$ " \times $2\frac{1}{4}$ " ... "	1	
$\frac{1}{8}$ " \times 2 " ... "	1	
$\frac{1}{8}$ " \times 2 " ... "	1	
$\frac{3}{32}$ " \times $\frac{3}{8}$ " ... "	2	
Pin, lynch, 1st class "B" capped wheels ... (spare)	1 (a)	In "off" limber box.
Pockets, key spring lock, 2 keys (b)	2	On limber box.
Pockets, tube, with strap ...	1	In "off" limber box.
Pump, hand, suction and force, screw-acting, No. 1 ...	1 (a)	In "near" limber box.
Rifles, short, M.L.E. ...	2	On footboard.
Ropes, drag, heavy ... pairs	1	In wire net receptacle.
" " " " " " "	1	On top of futchels, front of limber.
Ropes, hauling gun ...	2	
Screwdriver, G.S. 4-inch ...	1	In "off" limber box.
Spanners :—		
No. 337 ...	1	In "near" limber box.
" 338 ...	1	
" 339 ...	1	In "off" limber box.
" 340 ...	1	
" 341 ...	1	
Stays, outrigger ... (b)	2	On limber frame.
Swingletrees, No. 12 ... (b)	4	On limber frame.
" No. 12 ... (spare)	1	
Tallow, in box... lbs.	1	In "near" limber box.
Tommy, No. 45 ...	1	In "off" limber box.
" No. 46 ...	1	
Washer, drag, 1st class "B" capped wheels ... (spare)	1 (a)	In "off" limber box.
Wrench, adjusting, No. 7 dial sight and carrier ...	1 (c)	
Wrench, B.M., No. 194 ...	1	In "near" limber box.

(a) For each section.

(b) Component of limber.

(c) For 3 guns.

PART V.

CARE AND PRESERVATION.

GUN AND FITTINGS.

The breech fittings and also the projections on the exterior of the gun which form guides for the latter when sliding in the cradle, should be kept clean, oiled or greased and maintained in good working order; all working surfaces must be well lubricated, the fittings being taken off sometimes for this purpose.

The threads of the breech screw should be free from burrs; should the screw not work easily when the obturator has been detached, the defect may often be remedied by careful filing, but no portion of the thread should be cut away to remove a crack, &c.

Whenever possible, the breech should be kept covered by the breech cover to prevent dust and grit getting into the interstices of the breech fittings which might impede their easy working.

The obturating pad should be examined to see that the canvas covering is intact and in proper order for use. If the canvas cover is found to be loose or to overlap the front or rear rings the pad should be exchanged.

The spare pads will be kept under compression in the "Box, obturator."

The front protecting disc and rings should be carefully examined and if eroded, burred or cracked, they should be exchanged.

When fitting the obturator on the "vent, axial," care must be taken that the protecting disc, pad and rings are in correct order. The face of the pad marked "Front" should be towards the muzzle. One or more steel adjusting discs may be required between the obturator and the face of the breech screw when the pad is compressed by firing, but the obturator should always turn freely.

The obturating pad should be a close fit in the coned seating in the gun when the breech is closed.

In order to ascertain this, slightly cover the seating with grease (a mixture of oil and tallow), then close and open the breech, when the outer edge of the pad should be covered with grease from contact with the greased seating in the gun. When it is found after the above test that the pad does not fit the seating closely, adjusting discs should be added until the breech closes tightly and with some difficulty. The breech should then be opened and closed until the pad of the obturator becomes compressed. Before use the obturator should be well covered with tallow.

Every opportunity should be taken to keep the obturator and vent bolt cool. This can be done by pouring water over it in position or by sousing it thoroughly with a sponge during or after firing.

After a long rapid firing series the vent head becomes exceedingly hot and the pad very soft; when this is the case it should be thoroughly soused with water before taking apart.

LIST OF LUBRICATORS ON GUN.

Fittings to be Lubricated.	No. of Lubricators.	Position of Lubricator.
Bearing B.M. lever	1	On top side of carrier.
Safety shutter... ..	1	On top left side of carrier.
Carrier hinge joint	1	On top of hinge bolt.
Breech screw and pintle of carrier	1	On top side of breech screw.
Gun guides	2	One on each side.

LIST OF LUBRICATORS ON CARRIAGE.

Fittings to be Lubricated.	No.	Position of Lubricator.
Capsquare	2	One on each capsquare.
Elevating gear	1	Bracket elevating shaft.
" "	2	Elevating gear box.
" "	1	Bearing bracket elevating shaft.
" "	1	Right-hand centre bearing, elevating pinion shaft.
" "	1	Left-hand centre bearing, elevating pinion shaft.
Traversing gear	3	Pivot and gear box.
" "	1	Pin, link nut.
Trail clips	1	Clip, rear, trail, right hand.
" "	1	" " " left " "
Carriage clips	1	Bracket, front clip, carriage right hand.
" "	1	" " " left " "
" "	1	Traversing pivot.
Brake gear	2	Pivot pin, cranked levers.
" "	2	Bolt, brake, hinge bracket.
" "	2	Bolt, brake, arms.
" "	1	Nut, actuating, right hand.
" "	1	" " " left " "
Sighting gear	1	Sight rack bracket.
" "	2	" " " side cover.
Cradle	2	Front cap.
Cradle guides† ... each	4	Top of guides.

† Not required when lubricating pads are fitted to gun guides.

BUFFER AND RECUPERATOR.

IMPORTANT.

The following instructions should be rigidly adhered to, and only skilled artificers should be allowed to interfere with the recuperators.

The gun must be lashed to the cradle (or secured by other means) before the front cradle cap is removed.

If the cradle cap is to be left off for a long time, the elevating handwheel should be taken off.

The oil used for buffer and recuperator to be mineral oil.

It is essential to keep the oil clean and free from grit when filling. Sand or grit will cause damage to the recuperator or buffer.

The greatest care must be taken to see that the recuperator is correctly filled as too much liquid may cause serious damage and put the gun out of action.

When correctly filled, the front end of the recuperator tell-tale rod should be flush with the outside of the cover and the recuperator should contain 27 pints.

Before charging the recuperator with compressed air, it is important to see that the "block retaining" is in position on

the recuperator rod as this block bears against the recuperator gland and prevents the rod being forced out to the rear, when under pressure and disconnected from the front cap of the cradle.

The glands of the buffer, air reservoir and recuperator can be readily identified as they are stamped "BUFFER SIDE," "AIR RESERVOIR CENTRE" and "RECUPERATOR SIDE" respectively.

Do not tighten up the packings of the buffer and recuperator more than necessary to prevent leakage. Undue tightness is detrimental to the run out of the gun and wear of the working parts. The buffer cylinder gland should not be screwed up tight, as practical experience has proved that this packing gives the best results when allowed to "float."

Before firing the following points should be carefully watched:—

- (a) Buffer and recuperator must be properly filled and charged, and there must be no serious leakage at the glands.
- (b) See that the nuts securing piston rods to front cap and rear end of recuperator to breech lug of gun are in position and locked by the pins provided for that purpose.
- (c) See that the tell-tale of the floating piston is in correct position, *i.e.*, outer edge flush with the front of the cover.
- (d) See that the cut-off gear is correctly connected up and adjusted.

To Charge the Recoil System.

This should be carried out in the following order:—

- (1) Charge the recuperator with oil.
- (2) Charge the recuperator with air.
- (3) Fill the hydraulic buffer.

Note:—The gun should be horizontal or with a few degrees elevation.

The reference letter of each plug is stamped on the plug and also on the recuperator adjacent to the hole in which the plug fits.

To Charge the Recuperator with Oil.

- (a) Lash the gun to the cradle.
- (b) Remove plug "L" and open valve "M" to release all air pressure, then replace plug "L" and close valve "M." See Figs. I and II.
- (c) See that tell-tale rod is about .5" inside cover (this is to allow for a small leakage which usually occurs).
- (d) Remove cradle cap.
- (e) Remove plug "C" from recuperator rod and plug "B" from recuperator.
- (f) Attach adapter and oil pump connection on end of recuperator rod (plug "C").

(g) See that the bucket for the "Pump, liquid, portable No. 1" is empty and measure in about 28 pints of oil.

(h) Pump liquid into recuperator until liquid flows freely from hole "B," then stop pumping at once. About 1 pint should then be left in the bottom of the bucket.

(j) Replace plug "B," remove pump adapter and replace plug "C."

FIG. I.

VIEW OF FRONT END OF RECUPERATOR.

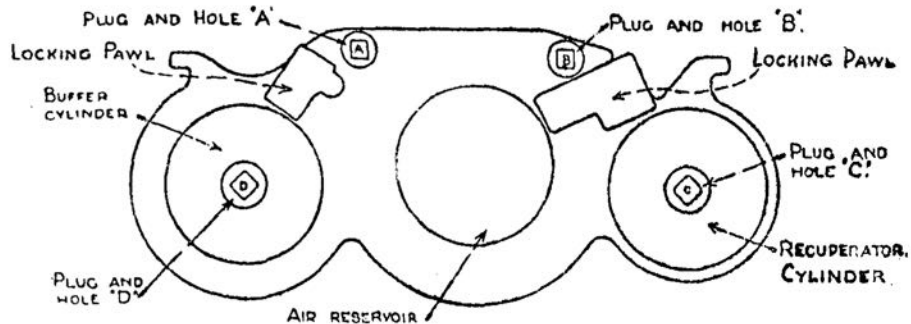
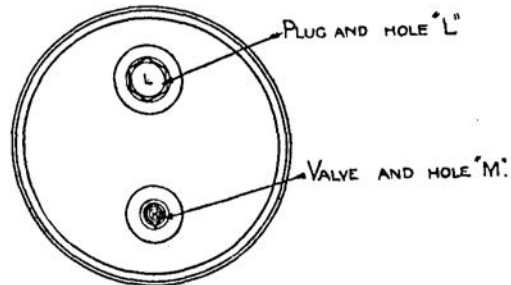


FIG. II.

VIEW OF REAR END OF RECUPERATOR EXTENSION.



To Charge the Recuperator with Air.

- (a) Remove plug "L."
- (b) Attach adapter for air charging, "Gauge, Pressure, No. 5" and air pump connecting pipe.
- (c) Open valve "M" and by means of the "Compressor, Air, Portable" pump in air until pressure stands at 610 lbs. per sq. inch, *i.e.*, plus 10 lbs. per sq. inch to allow for leakage.
- (d) Close valve "M" and remove air pump connecting pipe.
- (e) Screw cap on adapter, open valve "M" and adjust pressure to 600 lbs. per sq. inch.
- (f) Close valve "M" firmly and release oil if necessary to correct the position of the tell tale.
- (g) Remove adapter and replace plug "L."

To Let off the Air Pressure.

- (a) Remove plug "L."
- (b) Open valve "M."

To Test Air Pressure.

- (a) Remove plug "L."
- (b) Attach adapter for air charging with the end cap and pressure gauge screwed in place.
- (c) Open valve "M." The pressure registered on the dial should be 600 lbs. per sq. inch.

To Make up Air Pressure after leakage.

Proceed as for charging recuperator with air, but before opening valve "M," pump up pressure in the pipe to 600 lbs. per sq. inch.

To make up loss of liquid in Recuperator without reducing Air Pressure.

- (a) Remove plug "C" from front of recuperator rod, taking care not to interfere with the non-return valve.
- (b) Dip end of "Pump, hand, suction and force, screw acting" into a bucket of oil, and rotate handle rapidly to fill the pump with oil.
- (c) Screw pump into the recuperator rod and rotate handle so as to force the liquid into the cylinder until the tell-tale rod is in the normal position, i.e., outer edge flush with the front of the cover.

To Fill Buffer Cylinder.

- (a) Lay gun horizontal.
- (b) Remove filling plug from tank.
- (c) Keep the snifting valve pulled back to let out air.
- (d) Fill through tank with mineral oil until oil overflows from snifting valve. See that oil in tank shows about half-way up inspection window.

Total quantity required—about 24 pints.

In case of damage to the tank or connecting pipe the isolating valve should be tightly screwed down and if required the cylinder can be filled by unscrewing the body of isolating valve and pouring in liquid by means of a "Funnel, filling cylinder, No. 3" care being taken that the valve is screwed tightly in place before re-commencing firing.

To Empty Recuperator Cylinder.

- (a) Lash gun to cradle.
- (b) Remove plug "L" and open valve "M" to release all air pressure.
- (c) Remove cradle cap.
- (d) Remove plug "B."

- (e) Place a suitable receptacle in position to receive the liquid and remove stuffing box and retarding valve.
- (f) Drain off by depressing the gun a few degrees.
- (g) Replace retarding valve and stuffing box.

To Empty the Buffer Cylinder.

- (a) Lash gun to cradle.
- (b) Set cradle horizontal and remove cradle cap.
- (c) Place a suitable receptacle in position to receive the liquid and remove stuffing box from buffer and filling plug from tank.
- (d) Elevate and depress slowly a few degrees to drain tank.
- (e) Replace stuffing box and filling plug.

To Tighten Glands.

Open the small doors at the bottom of the cradle cap and tighten up the glands by means of the Tommy bar provided for the purpose.

It is advisable to tighten the glands when the cradle is warm as the packings will then pack better.

To Replace the Packing in the Stuffing box, Hydraulic buffer.

The gun should be securely lashed to the cradle and elevated to a convenient height so as to retain as much of the oil as possible in the rear end of the buffer. Remove the nuts of the piston rods, disconnect the cut-off gear and remove the cradle cap. Unscrew and remove the gland and stuffing box together with the defective packing, being careful to catch any oil that may run out in a suitable receptacle. Remove the old packing from the stuffing box and insert the new. Replace the stuffing box, gland and the cradle cap and the nuts of the piston rods. Connect up the cut-off gear and refill the buffer.

To Replace the Recuperator Piston Head Packing.

The air must be exhausted, the recuperator emptied of its liquid as described above and the recuperator body disconnected from the gun lug.

The gun is then forced back along the cradle to give clearance in working (supporting the rear end of the cradle if necessary), the securing nut and block retaining removed and the piston rod forced towards the rear. The old packing is then replaced by new, the parts replaced and the recuperator re-charged.

To Tighten Packing on Recuperator Piston Head.

Remove the dust cap and valve from the rear end of the cylinder by withdrawing the spring pin and swinging the strap into a clear position.

Screw up the packing by means of the special tool provided, the square spring plunger in the centre locks the adjusting nut.

To Replace the Recuperator Gland Packing.

This operation is the same as that described for the buffer except that the air must first be allowed to escape.

Stuffing Boxes and Glands.

The stuffing boxes are secured in position by locking plates and the glands by locking pawls; care should be taken when replacing the packing to replace the pawls and locking plates.

Snifting Valve.

This valve is used for releasing the air which accumulates under pressure in the buffer cylinder and prevents the gun from running fully out. It is operated by pulling the small ring at the rear end of the spindle actuating the valve, the gun being slightly elevated to allow the air to escape.

Valve Adjusting Run-out.

This valve is placed at the rear of the buffer cylinder and is operated by a special key through a hole in the right side of the cradle.

Should the gun not run fully home, insert the key and turn slightly in a counter clockwise direction, as indicated on the instruction plate above the valve.

Should the gun run home too violently, turn the key in the opposite direction.

Notes.—The key must be removed before firing the gun.

Care should be exercised in the manipulation of this and similar valves. These valves should be *operated without any additional leverage*

Tell-tale for Recuperator.

The front surface of the tell-tale should be flush with the front of the cover, but a safe margin is allowed for leakage of liquid.

When the copper band on the tell-tale rod is visible outside the cover, firing should cease and more liquid pumped in by means of the screw actuated pump.

Method of adjusting length of recoil.

A recoil indicator is provided on the left hand side of the cradle. Should the recoil at any angle of elevation be excessive the sleeve on the rod operating cut-off gear should be adjusted to suit. When the nominal working length of recoil has been obtained the sleeve should be screwed up 2 turns, shortening the recoil about 2.3 inches.

Emergency Cut-off Gear.

Should the cut-off gear become damaged from any cause the gun can be kept in action at any angle of elevation, by means of the emergency cut-off gear. The damaged gear should be taken off leaving the segment on the piston rod free to rotate. When the elevation of the gun has been decided upon the piston rod should be rotated so that the corresponding angle on the graduated ring in the front of the cradle cap is opposite to the index pointer on the front bush. The screwed spindle should then be screwed down so that the serrations on the locking piece engage with those on the segment, the screw being secured by the split pin.

Particular care must be taken when using this gear that the setting of the piston rod is altered to suit every change of elevation of the gun.

Should the recoil when using the emergency gear be found to be excessive due to wear of buffer cylinder, drop in air pressure, or any other cause, the rotation of the piston rod should be advanced a few notches.

General Instructions for Care of Carriage, Gears, &c.

Before putting in new rubbers see that they have the skin on the working surface and that they are flexible and free from scratches. Rubbers should be well steeped in oil if possible before putting in, or well oiled by hand.

See that all washers or rubbers and all working parts and parts of stuffing boxes are clean and free from grit before replacing them in the cylinder.

In removing the cradle from the carriage body it is necessary before lifting it out of the trunnion bearings to remove the outer roller race and in putting the cradle back, the last operation should be to fit this race in place.

If, during the run-up of the gun, it is noticed that liquid is forced out through the holes in the dust cap in the rear end of the recuperator cylinder it denotes loose or faulty packing on the piston head of the latter and it should be tightened up or exchanged.

Cradle.—It is essential that the guideways on the cradle in which the gun and recuperator body slide should be kept clean, free from burrs and well lubricated, otherwise excessive wear will occur on firing.

Elevating Gear.—To be kept clean, well lubricated and the teeth of pinions and wheels greased. If there is any play in the gear it should be taken up by manipulating the adjusting bush at the front end of the worm shaft.

Traversing Gear.—To be kept clean and well lubricated.

Wheels.—The grease chambers inside the pipe boxes must be kept full of grease. When it is required to replenish them the carriage or limber should be raised and the wheels removed. The axletree arm and the interior of the pipe box should be thoroughly cleaned and fresh lubricant supplied.

Wear in the direction of the length of the pipe box must be taken up by removing the dust cap and linch pin and turning the adjusting collar round to a shallower slot; then replacing linch pin and dust cap.

Shrinkage in the feet of the spokes must be taken up by tightening up the nuts of the nave bolts.

SIGHTING GEAR.

The carrier should be handled with care and kept free from rust. It should be lightly smeared with anti-corrosive grease when not in use.

No adjustment by filing or scraping is allowed without special authority, nor must the carrier or sight be unnecessarily taken to pieces.

No abrasive substance such as bathbrick or emery paper is to be used for cleaning.

The No. 7 dial sight, when issued, is in correct adjustment, watertight, and all the cells and joints secured by screws. It is very unlikely that the interior will be required to be cleaned and the dial sight must on no account be taken to pieces except by persons in possession of a certificate from the Ordnance College stating that they are qualified to do so. The body of the dial sight must be cleaned with a clean, soft cloth and a little oil, which must be rubbed off afterwards, care being taken that the glass is not touched. The exterior of eye lens and window should be cleaned with a silk cloth or chamois leather, which must be kept perfectly dry and clean and be used for this purpose only.

Dermatine or rubber eye-guards should not be unnecessarily exposed to extremes of temperature, to the sun's rays, or to bright light.

Oil and grease will inevitably destroy rubber or dermatine and prolonged contact with benzole, petrol and chemicals is undesirable. If, however, oil or grease gets on the eye-guard, it should be immediately removed, either.

- (a) By wiping with a clean rag soaked in benzole or petrol.
- (b) By washing in water to which a little soap and soda have been added.
- (c) By wiping off with a clean dry rag.

Spare eye-guards should be stored in a box completely filled with French chalk (so as to exclude air). The eye-guards should be packed in such a way that they are not distorted. If French chalk is not available the eye-guards should be kept under water.

If after being in store for some time the eye-guards lose their pliability they can generally be rendered supple when required for use by steeping them in warm water.

The No. 7 dial sight should be removed from the carrier before travelling any distance and when not in use must be kept in the sight box.

PART VI.

COMPRESSOR, AIR, PORTABLE.*(Plates XVI and XVII.)*

The compressor, which is hand driven, comprises a No. 2 two-stage vertical air pump, mounted in a stand.

The two-stage air pump consists of the following principal parts:—

Piston.

Eccentric (or crank) shaft.

Two eccentric rods (or straps).

Gudgeon pin.

Flywheel.

Sprocket and chain wheels.

Water cooled cylinder, with drain hole and plug for emptying purposes when compressor is not required for use.

Five valves.

The piston is in the form of a double ram. It is connected to the eccentric shaft by means of an eccentric rod fitted at each side of the gudgeon pin. A flywheel is fitted to one end of the eccentric shaft whilst a small sprocket wheel (14 teeth) is attached to the opposite end.

The large (low pressure) suction valve with plug cap and cover, is fitted horizontally at the bottom of the cylinder.

A small valve, with plug, cap and cover is also fitted horizontally to the bottom of the cylinder but on the opposite side and opposed to the large valve in action, thus allowing the expulsion of the air drawn in by the low pressure piston.

On the top of the cylinder a bye-pass valve is fitted horizontally and two small valves with caps, plugs and covers fitted vertically; one of the latter allows the passage of the first stage compressed air into the high pressure cylinder and the other the expulsion of the doubly compressed air into the recuperator cylinder of the carriage, through the bye-pass valve.

The stand is provided with two winch handles, two cranks for winch handles and a winch handle shaft which connects to the eccentric shaft of the pump, by means of sprocket wheels and chain.

Lubrication is effected by means of an adjustable sight-feed lubricator connected by a pipe to the large (low pressure) suction valve; also by the grease cup fitted to each of the two eccentric rods.

CARE AND PRESERVATION.—ALSO RUNNING INSTRUCTIONS.

All gearing, shaft bearings and driving chain must be kept well lubricated and free from dirt and grit as far as possible.

Before starting the compressor to work an outside examination should be made to see that the machine is clean and that no damage has occurred during transit.

The jacket should be filled with water and kept filled when in use, this is most important to prevent overheating. The lubricator feeding into the first stage suction valve must be set to feed at the rate of about eight drops per minute, the cover "37" on the suction inlet should be screwed back three or four turns and the compressor is then ready for use.

If the machine is working in an exposed position during frosty weather and is stopped and allowed to stand for any length of time, the jacket should be drained through the drain plug "35" provided for that purpose. If this is not done the cylinder may be fractured by frost.

When starting up again, if the jacket is empty, do not forget to refill it.

To keep the compressor in good working order it should be worked daily, half a dozen turns of the handles should suffice for this. It should also be kept covered to prevent dust getting into the working parts. This is most important.

The working pressure for this machine is up to 600-700 lbs. a square inch and should there be any falling off of the supply of delivered air the valves should be examined to see if they are clean; if they are found to be gritty the valves and springs should be removed and cleaned. If necessary grind valves lightly to seats, coat with clean thin oil before replacing. If efficiency of pump is not improved the piston rings should be examined and compressor head lifted off its base; rings should be taken out of piston grooves and tried in the cylinders. If spring of rings is destroyed the rings should be exchanged. When assembling the parts care should be exercised in seeing that all parts are clean and free from grit.

The joints between cylinder and base and cylinder should be carefully made with brown paper soaked in oil.

Grease cups are provided for the working parts and these should be kept charged with semi-solid grease.

Dismantling and examination can be carried out in the following manner:—

Both the second stage valves are placed in the top cover and are easily accessible by removing the caps "19" and plugs "20."

The first stage suction and delivery valves are placed horizontally and are equally accessible by removing the caps and plugs.

It will be seen that the first stage delivery and the second stage suction and delivery valves, together with their seats, plugs and caps, are interchangeable.

To examine the main bearings in the pedestal, remove the key "33" and the flywheel; the split pins and washers from the gudgeon pin "10," when the eccentric straps "6" can be removed from the eccentrics. The eccentrics should then be drawn off the feather keys, the latter removed from the shaft and the shaft drawn out of the bearing.

To withdraw the piston for examination, remove the securing pin "32," draw the gudgeon pin "10," unscrew the four nuts on the bottom flange of the water jacket, when the top part of the machine can be at once removed and the piston drawn out endways.

When charging, it is better to continue running the compressor from start to finish, changing men if fatigued without stopping. Should a stop be necessary the compressor will be much easier to start if the Recuperator valve is closed and the Relieving valve "36" opened on the delivery pipe. In that case, as soon as the compressor is started again, the valve "36" must be closed and the Recuperator valve opened.

When the compressing operation is finished open bye-pass valve "36," taking care that the valve on the Recuperator is first securely screwed down, also see that suction cover "37" is screwed up hand-tight to prevent dirt getting in and that the feed lubricator is turned off.

When compressors are fitted into housings with hand wheels and chains complete, a means of tightening the chain is provided by placing washers underneath the base of the compressor, which washers can be removed and the compressor lowered to the extent of $\frac{3}{16}$ inch to take up any slack on the chain due to wear or stretching of the same.

In all correspondence relating to the machine the number of the machine should be quoted and where spare parts are required the code words or numbers should be given.

The following data is a guide to locating faults:—

If no pressure is obtainable the fault may be due to one of the following causes:—

External Faults.

- (1) Release valve open, meshes of wire gauze choked, or in the case of pumps not fitted with filter probably suction cover not screwed back.
- (2) Pipe or adapter joints, cylinder cover, or valve caps leaking.

Internal Faults.

- (1) The L.P. inlet or L.P. delivery valves faulty, or valve seat joint defective.
- (2) Packing rings of L.P. or H.P. piston defective, or cylinders scored.
- (3) Air leak into water belt—due to faulty joint.

If pump is not working satisfactorily (with suction cover open), i.e., pressure rising slowly, the defect may be due to any of the above causes. Should the fault occur at high pressure it will be more probably due to defective H.P. delivery valve, H.P. packing, or scored H.P. cylinder.

Before charging recuperator it is advisable to test the pump system as follows:—

- (1) Close air charging valve on recuperator.
- (2) Work pump slowly till gauge registers 500 or 600 lbs. per square inch.
- (3) If the system is in good working order the gauge hand should now be stationary or only "creeping" back very slowly—the latter being permissible.

Should the hand fall quickly the system should be examined for external faults; if unable to locate the fault, it may be tested by smearing black wheel grease over joints, when air bubbles will be observable where there is a leak.

Note.—Great care should be exercised in using the gauge. When taking or releasing the pressure, the valve should be opened gently in order to prevent damage to gauge.

PART VII.

MISCELLANEOUS STORES.

Bit, vent, 14-inch.—This is of round steel furnished with a spiral bit at one end and hardened at the point; the opposite end is formed into a loop for convenience in handling. It is used for removing obstructions from the vent channel and for cleaning it.

Borer, vent axial, 303-inch chamber.—The borer is of steel and is for use in removing hard substances from the tube chamber, a cross handle is furnished at the outer end.

Box, obturator.—The box is of wood with metal bolt and fly nuts, to hold two obturators and adjusting discs.

Cleaner, Piasaba, No. 17.—The cleaner consists of a piasaba brush fixed on the middle portion of a length of 1-inch white rope which is formed with an eye at each end. A lead ball is attached by white line to one end of the rope so as to carry it through the bore of the gun.

Cover, breech, No. 3.—The cover is of service colour waterproof canvas and formed to envelop the breech end of the gun. It is provided with a pocket on the right side for the reception of the breech mechanism lever handle and a pair of white line lashings for securing it in position.

Cover, cradle and gun slide.—The cover is of service colour waterproof canvas and formed at the fore end to envelop the cradle cap, a pocket being provided for the reception of the projecting steel cover of the tail rod and a drain hole to form an outlet for moisture. The central portion of the cover is cut away at each end to clear the trunnions, the rear portion being formed with flaps which pass under the cradle and an extension piece which passes up over the gun.

The complete cover extends the full length of the cradle to which it is secured when in position by quick release lashings of white line passing through eyelets along the edge of the flaps and leather straps with buckling pieces one at each end of the cover.

Cover, Muzzle, No. 4.—The cover is made of khaki-coloured waterproof canvas shaped to suit the muzzle of the gun. It is provided with a leather strap to secure it in position.

Drift, No. 12.—The drift is of steel and is for use in removing and replacing the breech fittings.

Funnel, filling cylinder, No. 3.—The funnel, which is of block tin, is provided with a bent spout to fit into the filling hole of the buffer. It is used for filling the buffer in the event of damage to the tank or copper pipe.

Gauge, pressure, No. 5. (Plate XVIII).—The gauge generally consists of a metal cylinder containing the mechanism, which is closed in by a dial at the front and a sheet steel plate at the back.

The mechanism consists of a metal bearing which is attached to the cylinder and dial plate; that part of the bearing which is attached to the dial plate is flattened and suitable bearings are secured to it for the spindle of the dial indicator and for a crank through which the indicator is actuated, while that part of the bearing which is attached to the side of the cylinder has a channel which is in continuation of the connection; in one side of this channel is a hole in which one end of a short phosphor bronze tube (No. 4 gauge has steel tubing, owing to the high pressure it is subjected to) is inserted and soldered. The tube is slightly flexible and is bent partly round the cylinder, its opposite end being closed with a cap, to which is attached a crank arrangement working on a pivot and which has an adjustable arm attached to a segmental rack in gear with a pinion on the spindle of the dial indicator.

Each instrument is provided with a dial indicator stop, fixed either on the dial or within, against some part of the mechanism. Each one is constructed to register the pressure per square inch.

Action.—On pressure entering the bent tube within the gauge, it gradually inclines the tube outwards; thus the dial indicator is actuated through the pivoted crank and segmental rack. When the pressure is removed from the instrument, the dial indicator returns to stop at the normal position.

Gauge, striker protrusion, No. 10.—This gauge is of flat steel plate and is used for gauging the protrusion of the striker of the percussion lock "P.J." It has separate recesses for maximum and minimum gauging and the depths of the recesses are as follows:—

Maximum .065-inch.
Minimum .055-inch.

Handspikes, lifting.—These are of ash, 6 feet in length. The point is square in section to fit the brackets on the trail and is strengthened by a casing of mild steel plate.

Implements, Ammunition.—Key, No. 17.—The key is used for fixing No. 83 type of fuzes.

The *Mark II* key is made of steel, one end being shaped to fit over the fuze; the lower edge of the ring portion is bevelled to suit all *Marks* of fuzes without covers and is provided with a projection to fit the square notch in the flange of the fuze body. The upper edge of the ring is provided with a slot to fit over the projection on the cover when screwing in fuzes with cover.

The *Mark I* key differs from the *Mark II* in the upper edge not being prepared for use with fuzes with cover.

Implements, Ammunition.—Key No. 18.—The key is used for setting No. 83 type of fuzes.

The *Mark I* key is for use when the lower time ring is too stiff to set by hand. It is made of steel and formed to engage with the pin projection of the lower time ring. It is provided with a loop of white line, 30-inches in length.

The *Mark II* key differs from the *Mark I* in the ring portion being of greater depth, thereby taking a better seating on the fuze.

Implements, Ammunition.—Key No. 32.—This key is alternative to the No. 17, *Mark II* key, to which it is similar except that it is double-handled and instead of the projection for fixing the *Marks I to III* fuzes being formed solid in the key, it is made separately of hardened steel, wedge-shaped and driven into the key.

It is heavier and stronger than the No. 17.

Implements, Ammunition.—Key, No. 48.—Plugs, and No. 88 Fuzes.—The key is of steel and consists of a plain bar of steel, 10-inches long, $\frac{3}{4}$ -inch wide, having the ends slightly rounded off. It is for use in removing or inserting plugs having suitable slots, also with the slotted cap of the Fuze T., No. 188M.

Implements, Ammunition.—Key, No. 53—2-inch Percussion Fuzes.—This key is for use with 2-inch percussion fuzes.

Each end is semi-circular in shape with the inner edge chamfered and a projection formed to engage in the slot provided for the purpose.

Implements, Ammunition.—Key, No. 59—G.S. Special and 2-inch Plugs.—This key is for use in removing G.S. and G.S. Special fuze-hole plugs, also 2-inch fuze hole plugs except 2-inch No. 3, *Marks IV and V*.

It is made of steel. It is double handled, and consists of a 15-inch round bar passing through a centre portion, having a circular base recessed to fit over the plugs; a projecting rib, formed across the centre of the recess, engages in the key slots on the plugs.

A slightly tapered square projection is formed on the top of the centre portion for use with plugs having square recesses.

Indicators, Fuze, B.L., 60-pr.—The No. 3 *Mark I* fuze indicator is of wood with white enamelled scale plates and consists chiefly of a base plate, reader, reversible fuze slide and corrector scale plate.

The upper part of the base plate is fitted with an enamelled plate strip which is graduated with an elevation scale reading from 2 degrees to a maximum of 35 degrees 30 minutes, in multiples of 10 minutes, but from 2 degrees to 12 degrees 30

minutes, the 10-minute divisions are sub-divided, each sub-division representing 5 minutes and denoted by a dot. The whole degrees are numbered. The top edge of the strip is bent over at right-angles to form a bearing, on which slides a brass reader. A stop screw at each end of the strip prevents the reader from sliding off and becoming lost.

Secured to the lower part of the base plate is an enamelled strip marked with an arrow head for reading the M.V. corrector scale, and on top of the strip is attached a movable corrector scale plate by two screws passing through elongated slots at each end. The upper edge of the scale plate is graduated with a fuze corrector scale reading from 0 to 200 in multiples of 10 (150 being the normal), which is read by an arrow head on the fuze slide. At the lower edge of the plate is a M.V. corrector scale graduated in multiples of 25 f.s. to 75 f.s. above and 175 f.s. below normal, the normal position being denoted by the word "normal" marked on the plate. The M.V. corrector scale is for the purpose of correcting variations in muzzle velocity of individual guns, due primarily to wear. The plate is clamped in the required position by its screws.

The centre of the base plate is grooved to take a reversible fuze slide, each side of which is provided with an enamelled plate strip marked in fuze settings to suit the No. 94 T. and P. fuze when used with 8 c.r.h. shell. One side being for "full" and the other for "reduced" (6-lb. 6-oz.) charges.

Use.—To use the indicator apply the muzzle velocity correction on the M.V. scale and clamp it, move the fuze slide until the arrow head coincides with the corrector ordered. Set the reader at the elevation ordered and the fuze setting nearest to the straight edge of the reader will be the correct length of fuze to employ.

Note.—The fuze setting must be that for the gun range and not map range.

The *No. 4 Mark I* fuze indicator differs from the *No. 3 Mark I* in the following particulars:—

It is of delta metal instead of wood, and the graduations are engraved on the indicator instead of being marked on enamelled plate strips as in the case of the *No. 3 Mark I*.

The elevation scale on the base plate reads from 1 degree 30 minutes to a maximum of 36 degrees, in multiples of 10 minutes.

The reversible slide is graduated on both sides in fuze settings to suit the No. 88 T. and P. fuze, when used with 8 c.r.h. shell. One side being for "full" and the other for "reduced" charges.

The fuze slide can be clamped in position by means of a clamping handle and thus slipping is avoided.

The reader is held in position when once set by means of a spring and tension screw.

Two hooks are provided for hanging the indicator in a convenient position when in use.

STRIPS, FUZE, SCALE, PAPER, B.L. 60-PR. NO. 4 FUZE INDICATOR.

The undermentioned paper fuze scale strips have been adopted for use with the No. 4 fuze indicator, they are graduated for the following purposes:—

Range table.	Strip.	Combination of Ammunition.
40/WO/6040	A	{ 2 c.r.h. projectile. No. 88 fuze. Full charge.
40/W/7498	B	{ 2 c.r.h. projectile. No. 88 fuze. Reduced charge.

Lanyard, firing, No. 35.—The lanyard is of hemp, 57 inches long. It is fitted at one end with a steel firing peg for insertion in the percussion lock "P.J."; the opposite end is furnished with a toggle and loop.

Lever, front nuts, buffer and recuperator.—This lever is of tubular steel, 3-feet long. It is used for removing or replacing the nuts securing the piston rods of the buffer and the recuperator.

Measure, filling hydraulic buffer, No. 1.—This measure is of tin and holds one gallon. There are ribs round the inside surface by which 1-quart, 1-pint, $\frac{1}{2}$ -pint and $\frac{1}{4}$ -pint may be measured. The lower end is provided with a spout and fitted tap. It is fitted inside with a wire gauze strainer.

Press, obturator. Gauge, thickness, obturator. Tommy, press, obturator.—The press and gauge are intended for use in reforming obturators which have become so distorted as to cause difficulty in placing them in position on the axial vent in the gun.

The press consists of a steel body, shaped internally to suit the contour of the obturator and fitted with a steel cover. The cover is secured by means of a steel bolt with disc spring washer and cross handle. The bolt is provided with a square head, by means of which the press can be held in a vice while the cross handle is revolved when compressing or releasing the obturator. A steel tommy is provided for use with the cross handle in compressing the obturator. Recesses are formed round the periphery of the press so as to admit of the application of the gauge for testing the thickness of the obturator while under compression.

The gauge is of flat steel plate and is for use in testing the thickness of the obturator.

Pump, hand, suction and force, screw acting, No. 1.—This pump is used for making good any loss of liquid from the recuperator without releasing the air pressure. It consists chiefly of a steel cylinder with cap in which works a packed rod. The cylinder is furnished with a screwed nozzle at one end for screwing into the front end of the recuperator rod, the opposite end is closed by the steel cap which is threaded to take the rod. The rod is threaded throughout its length, its outer end is fitted with a radial handle and its inner end with a packed piston. The

piston packing consists of a cupped leather ring supported by a spring steel ring and a brass washer.

For instructions in the use of the pump, see "Care and preservation of the buffer and recuperator." Page 47.

Pump, liquid, portable, No. 1, Mark I.—This pump is used to charge the recuperator with liquid. It consists of a cylindrical steel bucket provided with a lid. There are brackets inside the bucket, in which the pump is secured by a bayonet joint. The pump proper consists of a vertical cylinder divided into two chambers, in one of which works a packed plunger actuated by a grip handle at the top. The lower end of the pump is perforated for the entrance of liquid, which enters into the plunger chamber through an inlet valve. The bottom of the second chamber is fitted with a delivery valve and its top end has a screwed delivery nozzle, to which is attached a length of flexible hose, which connects the pump to the recuperator piston rod.

Rammer and sponge.—The *Mark III* rammer and sponge is of the double-ended type and consists of an ash stave having the rammer head at one end and the sponge head at the other. The rammer head is of elm and is protected on each end by a copper band. The sponge head consists of an elm stock provided with rows of wool tufts and a copper protecting band on each end; the wool tufts are secured by pitch composition and wire. The heads are secured on the stave each by copper rivets and when unserviceable can easily be removed and replaced by new heads. The overall length of this sidearm is 6 feet.

Rimer, vent axial, 303-inch chamber, No. 2.—The rimer is of bronze and steel, the bronze portion being shaped to suit the chamber for "Tube, percussion, S.A. cartridge."

Tool, adjusting isolating valve.—This tool is of steel; it is furnished with a "T"-shaped handle at one end and a square projection at the other, which fits in the recess at the end of the spindle of the isolating valve. It is also for use with the run-out control gear and on emergency can be used for setting the reader of the M.V. scale of the "Carrier, No. 7 dial sight, No. 9."

PART VIII.

AMMUNITION.

Projectiles.					Nature of fuzes.††	Cartridges.			Means of Firing.
Nature.	Mark. (a)	Bursting charge.		Average weight filled and fuzed.		Nature.	Size.	Weight.	
		Nature.	Weight.						
Shell, B.L., High Ex- plosive, 60-pr.	IX.C.	H.E.	lb. oz. dr. 6 2 0	lb. oz. dr. 60 0 0	Fuze, Percussion, D.A., No. 106.	Cordite, M.D. or R.D.B.	15	lb. oz. dr. 9 7 0	Tube, Percussion, S.A. Cartridge.
	X.C.	H.E.	6 0 8	60 0 0	Fuze, Percussion, D.A., No. 106E. Fuze, Percussion, No. 101 or 101E (v). Fuze, Time, No. 188M with No. 12 adapter (d).†	Cordite, M.D., M.C. or R.D.B.	16	9 7 0	
Shell, B.L., gas, 60-pr....	V.C.	—	—	60 0 0	Fuze, Time, No. 194M with No. 12 adapter (d)† (b). Fuze, Percussion, D.A., No. 106.	Cordite, M.D. or R.D.B.	11	6 6 0‡	
Shell, B.L., shrapnel, 60-pr.	IV.C.	Powder.	4 0	60 0 0	Fuzes, Time and Per- cussion, Nos. 88 or 94 (b).	Blank, L.G. powder.	—	3 0 0	
—	—	—	—	—	—	—	—	—	

(a) Other marks may be met with.

(b) Obsolete for future manufacture.

(d) With No. 2 gaine.

† For air ranging.

† Reduced charge.

†† When stocks of Nos. 106 and 101 fuzes are exhausted they will be superseded by Nos. 106E and 101E respectively.

CARTRIDGE, B.L., 60-PR., 9-LB. 7-OZ. CORDITE, M.D. or R.D.B.,
SIZE 15.

(Plate XX.)

The *Mark III* cartridge is made up of cordite M.D. or R.D.B. respectively.

The body of the empty cartridge is made up of silk cloth or cream serge sewn to two discs of shalloon which are stitched across to form four parallel compartments with an igniter 60-pr. "A" which consists of 16-drams R.F.G.² or S.M.¹ powder sewn to each end of the bag.

The charge consists of a cylindrical bundle of M.D. or R.D.B. size 15 cordite sticks, 17.25-in. long, tied in four places with No. 1 silk sewing.

These cartridges are packed 10 in a "Case, powder, M.L.; whole."

CARTRIDGE, B.L., 60-PR. 9-LB. 7-OZ. CORDITE, M.D., M.C. or
R.D.B. SIZE 16.

The *Mark IV* cartridge is made up of cordite M.D. cut about 16.4-inches long.

It is generally similar to the size 15 *Mark III* cartridge described above.

These cartridges are packed 12 in a "Case, powder, M.L. whole."

CARTRIDGE, B.L., 60-PR. 6-LB. 6-OZ. CORDITE, M.D. or R.D.B.,
SIZE 11.

REDUCED CHARGE.

(Plate XXI.)

The *Mark I* cartridge is made up of cordite, M.D. or R.D.B. respectively.

The cartridge consists of 6-lb. 6-oz. cordite, M.D., or R.D.B. size 11, enclosed in a silk cloth or cream serge bag, fitted at each end with a 60-pr. "A" igniter, which consists of 16-drams R.F.G.² or S.M.¹ powder sewn to each end of the bag.

The charge consists of a cylindrical bundle of size 11 sticks of M.D. or R.D.B. cordite tied in three places with silk sewing.

A red band, 1-in. wide, is painted round the centre of the bag and the marking stencilled in red instead of black to distinguish it from other reduced charge cartridges.

These cartridges are packed 12 in any of the following packages:—"Case, powder, T.L., whole"; "Box, cartridge, C.¹ 125" or "Case, Powder, M.L., whole."

CARTRIDGE, B.L., 60-PR., 3-LBS., BLANK, L.G., MARK I.

The cartridge consists of 3-lbs. blank L.G. powder contained in a No. 1 silk cloth or cream serge bag furnished with four hoops of silk braid and choked with No. 1 sewing silk.

The precautions to be taken when firing blank ammunition are detailed in Appendix VII, Artillery Training, Volume II. 1920.

SHELL, B.L., 60-PR., HIGH EXPLOSIVE.

(Plate XXII.)

Mark IXc.—This shell is made of forged steel with an eight calibre radius head, fitted at the nose with a gunmetal fuze socket to permit of the use of a metal exploder container. The fuze socket is screwed to the 2-in. fuze-hole gauge and is provided with a fixing screw. Alternatively the fuze-hole may be formed in the head of the shell itself. A steel plate disc is screwed in the base, or alternatively a plain steel plate disc is riveted in. A copper driving band is fitted near the base into an undercut groove having two waved ribs.

	Inches.
Length (maximum)	18.93
Diameter—	
Body (maximum)	4.99
Driving band (maximum)	5.21

Mark Xc.—This shell is made of forged steel and is fitted with a removable head to make it suitable for block filling, the head being secured by a fixing screw and struck with a radius of eight calibres. A fuze hole socket, to permit of the use of a metal exploder container, is formed in the head proper.

The socket is screwed to the 2-inch fuze hole gauge.

A 3.375-in. steel plate disc is screwed into a recess in the base or alternatively a plain plate disc is riveted in.

A copper driving band is fitted near the base into an undercut groove having two waved ribs.

	Inches.
Length (maximum)	18.84
Diameter—	
Body (maximum)	4.99
Driving band (maximum)	5.21

SHELL, B.L., GAS, 60-PR. MARK Vc.

(Plate XXIII.)

This shell is converted from the H.E. *Mark IXc* described above from which it differs in the head being fitted with a container to take the bursting charge, the latter being threaded internally to the 2-inch fuze hole gauge.

A tapered charging hole is drilled in the body of the shell below the shoulder and is closed after charging by driving in a steel charging hole plug.

SHELL, B.L., 60-PR. SHRAPNEL.

(Plate XXIV.)

Mark IVc.—The shell consists of a steel body with a solid base and a steel or malleable cast iron head, struck with a radius of eight calibres.

The head is threaded to the 2-inch fuze hole gauge and is secured to the body by eight screws and eight twisting pins, the interior of the top of the body being recessed to form a seating

for the bottom of the head. A cylindrical wood block, or alternatively, a shaped composition block is fitted in the head, a felt washer being placed underneath the block when made of wood.

The interior of the body at the base is recessed to take a tinned plate cup containing a bursting charge of 4-ozs. R.F.G.² powder.

The walls of the shell are parallel, tapering off towards the head, and may be lined with brown paper.

The shell contains about 681 bullets (34 or 35 per lb.) set in resin and supported by a steel disc placed over the tin cup. Buckshot or iron shot may be used to regulate the weight.

A metal central tube conveys the flash of the fuze to the bursting charge; the lower end of the tube is screwed into the steel disc, the upper end is soldered or expanded into a recess in the bottom of the fuze hole socket.

Near the base of the shell a driving band is fitted into an undercut groove having two waved ribs formed in it, or alternatively, the groove is knurled.

	Inches.
Length (maximum)	16.14
Diameter—	
Body (maximum)	4.99
Driving band	5.21

FUZES.

INSTRUCTIONS RELATING TO THE CARE OF NO. 106 AND 106E FUZES.

(1) The (safety) cap of the No. 106 and 106E fuzes must be removed and the wire seal broken *only* immediately prior to firing.

(2) If a No. 106 or 106E fuze has become uncapped in any manner, except that referred to in (1) or has the wire seal inadvertently broken, it is to be regarded as unfit for firing and is to be withdrawn from use.

(3) Fuzes withdrawn, under paragraph (2) are to be examined to ascertain if the brass tape under the hammer head is present and correct. If this is so, the (safety) cap should be replaced and secured in position by a becket and the fuze returned to the Ordnance Store for transmission to Woolwich. If examination shows that the brass tape is incorrect, or missing, the fuze may be in a *dangerous condition*, and must be destroyed under expert supervision.

In securing the (safety) cap with the becket, difficulty may arise with fuzes, where the body is not provided with an eye through which the becket may be threaded. In such cases, wooden pegs should be driven into the fixing key holes in the body and the becket fastened round these.

(4) It is essential that the becket should be fastened in such a manner, so as to prevent the cap coming off in transit to Woolwich. The method of fastening the fuze-cap is as shown on Plate XXIVA.

FUZE, PERCUSSION, D.A., No. 106E.

(Plate XXV.)

The *Mark IV* fuze consists of the following principal parts:—Body, cap, hammer, steel collar in halves, brass tape with weight, steel and dermatine washers, copper shearing wire, steel guide pin, detonator holder, detonator, magazine with shutter, shutter spring, bottom screwed cap, shalloon and paper discs.

The *body*, which is made of bronze, is screw-threaded externally at its lower end to suit the 2-inch fuze-hole gauge. Its upper end, which is generally conical in shape, terminates in a cylindrical stem, which is screw-threaded to receive the cap. Slots are cut in the body to receive the No. 53 key for fixing purposes. The body is further prepared to receive a shearing wire, guide pin and a countersunk hole to take the wire securing the cap. A groove is cut round the shoulder for punch stabbing the fuze into the shell when fuzing the latter.

Internally the body is bored out in different diameters to receive the hammer, detonator holder and magazine.

The *hammer* is of steel, fitted with an aluminium head. The lower end is pointed to form a needle. Just below the head a recess is bored to take a stud on one-half of the steel collar and in one side a slot is cut through which fits the shearing wire and guide pin. The hammer is placed in position from the top of the fuze body passing through a steel washer on the top of the latter. The guide pin is screwed into the body, one end entering the slot in the hammer. The shearing wire passes through the body and hammer, the ends being afterwards turned over. The function of the guide pin is to prevent the hammer turning whilst the tape is being wound or unwound, while the shearing wire keeps the hammer clear of the detonator after the collar has become detached until the shell strikes. Around the hammer, under the head and resting on the steel washer of the body, is a steel collar in halves, one-half of which has a pin to fit the recess in the hammer, and around this again is wound a brass tape to one end of which is soldered a weight. The top of the fuze is then closed by a U-shaped steel or malleable cast iron cap which screws on to the projection at the top of the body against a dermatine washer and is held in position by a steel wire which passes through an eye in the cap the two ends being twisted, a complete turn is then taken round the cap and the loose ends inserted in the hole provided in the body and fixed therein by a lead plug pressed in.

The *steel collar and tape* prevent the hammer moving on to the detonator until they have been freed by the rotation of the shell during flight and so prevent any possibility of a premature in the bore or near the muzzle.

The *detonator holder* is held in position by the top surface of the magazine. Its upper end is recessed to receive the detonator, which is held in position by the mouth of the holder being spun over. A cupro-nickel or brass disc is placed on top of the detonator. An opening is bored through the centre of the holder

which is filled with loose "composition, exploding" the opening being closed by a paper disc shellaced to the bottom of the holder.

The *magazine* is screwed externally to suit the interior of the body and is reduced in diameter near the bottom and screwed to receive the bottom cap. The top of the magazine is recessed and fitted with a shutter and spring which swings open when the fuze is spun during flight. The bottom of the magazine is bored out to contain a compressed C.E. pellet and is closed by the bottom cap.

A set screw is screwed into a hole in the body of the fuze and holds the magazine in position.

Preparation of Fuze.—To prepare the fuze the wire is broken and the cap unscrewed and removed at the moment of loading.

Action.—On de-acceleration after leaving the bore the rotation of the shell causes the weight on the tape to fly outwards, causing the latter to become unwound from the steel collar; the steel collar in turn drops off, leaving the hammer supported only by the shearing wire.

The rotation of the shell during flight causes the shutter to swing outwards until a hole formed in it comes into line with the central perforation in the detonator holder and on impact the hammer is driven in, breaking the shearing wire and piercing the detonator. The consequent detonation passes through the loose "composition, exploding" in the detonator holder to the magazine, which in turn detonates the charge in the shell.

The *Mark IVs* fuze differs from the *Mark IV*, in the head of the hammer being made of steel, instead of aluminium.

These fuzes are packed one in a tin cylinder, No. 101F, with exploder.

FUZE, PERCUSSION, D.A., No. 106, MARK V.

(Plate XXVI.)

This fuze is generally similar to the No. 106F described above from which it differs principally in not having a removable magazine with safety shutter.

FUZE, PERCUSSION, No. 101E, MARK II.

(Plate XXVII.)

The fuze consists of the following principal parts:—

Body, cap with needle, graze pellet, plug, detonator, creep spring, centrifugal bolt, detent, detent spring, safety shutter and adapter.

The body is screw-threaded externally at its lower end to the 2-inch fuze hole gauge, while its upper end is conical in shape and fitted with a rounded cap which is screwed into the upper end. Below the cap the body is bored out to receive the graze pellet and below this again a fire channel leads to the safety shutter. A second opening, of two diameters, is bored in the body parallel to the fire channel for the reception of the detent and its spring; after assembly and inspection of the empty fuze this opening

is closed at the top by a brass or copper ball. Near the upper end of the opening of the larger diameter and through that of the smaller diameter a hole is bored at right angles for the centrifugal bolt. Around the outside of the body is a knurled ring, black band or groove to denote that the fuze is not fitted with a cocked pellet and slots are provided to receive the Key No. 53 for fixing purposes. A groove is formed round the lower end of the body for the purpose of punch stabbing the fuze into the shell.

The lower end of the body is bored out and screwed to receive an adapter.

The cap, which is screwed into the upper end of the body, has a steel needle screwed in from the top.

The *graze pellet* is hollow and is screwed internally at its lower end for the plug. Its upper end is stepped to form seatings for the centrifugal bolt and creep spring. The space between the bottom of the pellet and the top of the shutter is filled by a paper cylinder.

The *plug* which is screwed into the graze pellet from the under side, has a central fire channel through it. It forms a support for the detonator.

The *detonator* consists of a copper cup containing 1.7-grains of detonating composition; the top of the composition is covered by a brass disc and copper washer and its underside by a brass disc, the whole being held in the cup by the top edge of the latter being spun over. It fits inside the graze pellet, in which it is held by the plug.

The *creep spring* is interposed between the upper end of the graze pellet and the underside of the cap.

The *centrifugal bolt* is fitted in an opening at the upper end of the body, the opening being closed by a screw plug. The bolt is kept in position by the stem of the detent, which passes up behind it. Its inner end fits over a shoulder on the upper end of the graze pellet.

The *detent* consists of a body with pin connected by a ball and socket joint; the stem of the latter passes up through a hole in the top of the fuze and behind the centrifugal bolt and is kept in position by a spiral spring which bears against the underside of the body and is held in position by a plug screwed into the body of the fuze.

The *safety shutter* consists of a metal shutter which is slotted at one end to take the stem of the detent and a spiral spring, the whole being supported on a metal disc having a central fire hole. The detent, shutter and spring are carried in a groove in the top of the adapter and are secured in position by a tinned plate cap having a central fire hole. The cap forms a bearing for the head of the detent and the shutter spring.

The *adapter* is screwed externally at its upper end to screw into the bottom of the fuze, in which it is held by a set screw and internally for the greater part of its length to receive the gaine, which in turn is held by a set screw. The upper end of the

central opening is plain and enlarged to form a chamber for the reception of the safety shutter.

Action.—On firing, the detent behind the centrifugal bolt sets back, compressing its spring. When the stem of the pin is clear of the fuze body, centrifugal force carries the stem over and the spring, reasserting itself, jams it under the shoulder of the recess. This leaves the centrifugal bolt free and the rotation of the shell causes the bolt to move outwards and so unlock the graze pellet. Whilst the shell is under acceleration in the bore, the comparatively slow rate of rotation and the friction caused by the set back of the shutter prevents the latter opening. After the shell has left the bore the shutter is moved outwards by centrifugal force, compressing the spring. In moving outwards it releases the detent, the stem of which drops down and engages a shoulder in the shutter and thus keeps the shutter clear of the fire-holes in cap and disc. During flight the graze pellet is prevented from moving forward by the creep spring, but on graze or impact it moves forward, carrying the detonator on to the needle. The flash from the detonator passes down through the fire channels to the gaine, which in turn detonates the bursting charge in the shell.

Packed one in a No. 101F tin cylinder.

FUZE, PERCUSSION, No. 101, MARK II.

This fuze differs only from the "Fuze, percussion, No. 101 E" in not being fitted with a safety shutter.

FUZE, TIME AND PERCUSSION, No. 88.

(Plate XXVIII.)

The *Mark V* fuze consists of the following principal parts, which are made of gunmetal except where otherwise stated:—Body, percussion pellet with detonator, ferrule, spiral spring, stirrup spring and steel ball, time pellet with detonator, screwed needle, brass pins and washers, base plug, screwed plug, top and bottom composition rings and cap.

The *body* is screwed at the lower end to the 2-inch fuze-hole gauge and bored from the bottom to receive the percussion arrangement. It is further bored to form a magazine which is filled with fine grain powder and closed with a brass plug; an oblique hole leading upwards from this magazine to connect with the bottom composition ring is filled with fine grain powder. A vertical recess is drilled centrally in the stem of the body to take the time arrangement, with a fire channel leading to the top time ring. A double pointed needle is screwed into the diaphragm separating the recess for the time arrangement from the opening in the base to take the percussion arrangement. The stem of the body is fitted with two slots for pins to prevent the top composition ring from turning and is screwed to take the cap. The cap, which may as an alternative be made of mild steel rust-proofed, is threaded internally to fit the stem of the body; a slot is cut across the top to take the "key, No. 48," or a screwdriver for clamping purposes when setting.

The flange of the body is engraved with graduations from 0 to 22 (in tenths) and with an arrow point in red to denote position of "safety." When the arrow and the line on the bottom ring coincide the fuze is set at "safety."

A slot in the flange of the body takes the "key, No. 17," or "key, No. 32," for fixing purposes.

The *percussion pellet*, which is held in position by the spiral spring, ferrule, stirrup spring, steel ball and screwed plug, contains a 1.7-grain composition detonator.

The *top and bottom composition rings* have a channel on their under side filled with composition, the top ring being filled with No. 83 fuze composition and the bottom ring with special composition, a hole is provided in each which allows the gas direct escape outside; this escape hole is lightly closed by means of a brass disc covered without by Pettman's cement and water-proofed. Two semi-circular slots are cut on the inside of the top ring, which, in conjunction with the two slots in the stem and two pins, prevent the ring from turning.

A hole is bored in the top ring to convey the flash of the time detonator to the composition. A similar hole is bored in the bottom ring to convey the flash from the top ring. A cloth and vegetable paper washer is placed between the rings and between the bottom ring and the body. The bottom ring is fitted with a setting pin to take the "key, No. 18," and is engraved with a line for setting purposes.

The exterior of the bottom time ring is lacquered red to indicate the special filling.

The *time pellet* contains a .75-grain detonator and a powder pellet and is supported above the time needle by means of a spiral spring.

The *baseplug* is screwed externally to fit the bottom of the body. A hole is bored through the centre and a recess is formed to take a brass and linen disc, the metal of the plug being burred over to hold them in position.

The *screwed plug* is screwed externally to suit the recess in the body. The interior is recessed to receive the flange of the percussion pellet.

The openings in the fuze are filled with waterproof composition.

To set the fuze.—Unclamp the cap and with the "key, No. 18," or by hand, revolve the bottom ring until the vertical line coincides with the required graduation on the body. Then clamp the cap and check the setting.

If the fuze is required to act on percussion only, it should be set at "safety" and clamped.

Action—time arrangement.—On discharge, the time pellet sets back on the time needle, overcoming the resistance of the spiral spring and firing the detonator. The flash passes through the fire channel in the stem to the composition in the top time ring, which burns until the channel communicating with the bottom time ring is reached, the composition of which burns in the opposite direction until it reaches the channel leading to the magazine in the fuze, whence the flash passes through the base plug into the shell.

Percussion arrangement.—On shock of discharge the ferrule sets back, straightening the horns of the stirrup spring and releasing the steel ball, which, through centrifugal action, passes into a side channel prepared for it in the body of the fuze. The pellet, being now held only by the spiral spring, is free on impact to move forward on to the detonator, the flash of which passes through the hole in the pellet and base plug into the shell.

Mean time of burning, at rest, set full, after correcting for barometer, 48 seconds. Weight, 1-lb. 10½-ozs.

The fuze is fitted with a rubber cover and packed one in a tin cylinder, No. 87F, Mark III.

FUZE, TIME, No. 188 M, MARK V.

(Plate XXIX.)

This fuze differs from the No. 88, *Mark V*, described above, in having the percussion arrangements removed and replaced by a wood plug driven in: a perforated powder pellet is inserted in the magazine in place of a charge of powder, the pellet being retained in position by a paper disc placed over the pellet and secured to the base plug with shellac. These fuzes are distinguished by having a 1-inch "T" stencilled on in blue.

FUZE, TIME AND PERCUSSION, No. 94, MARK V.

This fuze is similar to the T. and P. No. 88, *Mark V*, described above, except that the time rings are filled with long burning composition: the mean time of burning, set full, is 42 seconds. These fuzes are distinguished by having the top and bottom composition rings lacquered or enamelled blue.

FUZE, TIME, No. 194M., MARK V.

This fuze differs only from the T. and P. No. 94, *Mark V*, described above in having the percussion arrangements removed and replaced by a wooden plug driven in. A perforated powder pellet is inserted in the magazine in place of a charge of powder, the pellet being retained in position by a paper disc placed over the pellet and secured to the base plug with shellac. These fuzes are distinguished by having a 1-inch "T" stencilled on in blue.

ADAPTER, 2-IN. FUZE-HOLE, No. 12.

This adapter is made of steel or metal, and is for use with time fuzes and No. 2 gaine in H.E. shell.

It is screwed on the exterior to the 2-inch fuze-hole gauge for a certain distance, below which it is turned plain. A hole is bored out from the bottom and screwed to receive a No. 2 gaine, and a groove is cut across the top to accommodate a shutter which is retained in position by a perforated tinned plate cap soldered to the top of the adapter.

GAINE No. 2.

The gaine, which acts as an exploder to H.E. shell, is made of steel and consists of a hollow cylinder containing explosive. The

cylinder is screwed externally at one end to suit the screwed recess of the adapter with which it is used. The screwed end of the cylinder is closed with a shellacked disc and the opposite end with a screwed plug or cap.

TUBE, PERCUSSION, S.A. CARTRIDGE, MARK I.

(Plate XXX.)

This tube is used with guns or howitzers having modified firing mechanism. The form and general dimensions are shown on Plate XXX. It consists of a body with cap and cork disc.

The body and cap consist of the .303-rifle cartridge-case filled with a charge of 30-grains, S.M.¹ or R.F.G.² powder. It is closed at its front end with a cork disc, which is covered with shellac varnish before insertion and the exposed side afterwards water-proofed with shellac.

Packed 20 in a "Box, Tube, Percussion, S.A. Cartridge."

TUBE, PERCUSSION, S.A. CARTRIDGE, DRILL, MARK I.

The drill tube consists of a .303-inch cartridge case with the anvil removed from the cap chamber and the body filled with a wood plug secured by the neck of the case being indented into it in three places. Three elongated indents equally spaced are formed in the case and filled with red paint to distinguish it from the service tube.

NOTES.

In the event of a tube failing to ignite, care should be taken in extracting the fired tube not to stand directly in rear of the gun, as the gas generated will cause the tube to fly out with some violence so soon as the lock is clear.

The vent channel sometimes become choked with residue from the cartridge. When this occurs the taper portion should be cleared with a "Rimer," sufficiently to allow of the insertion of a tube, which, when fired, will remove the rest of the obstruction.

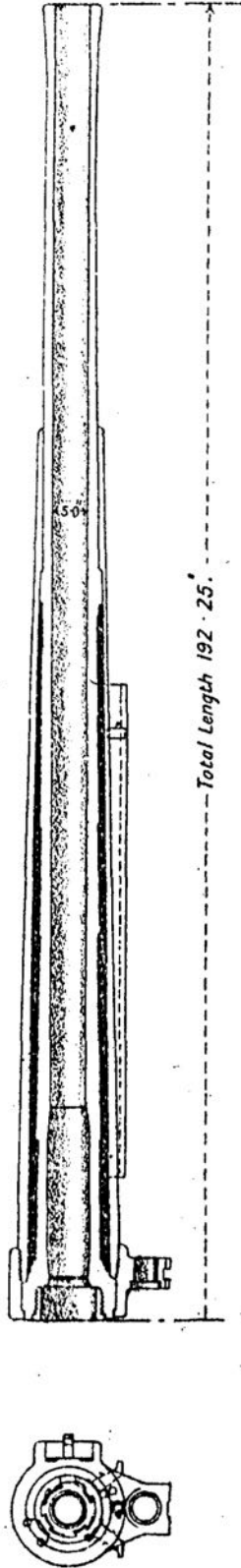
By Command of the Army Council,



THE WAR OFFICE,
August, 1921.

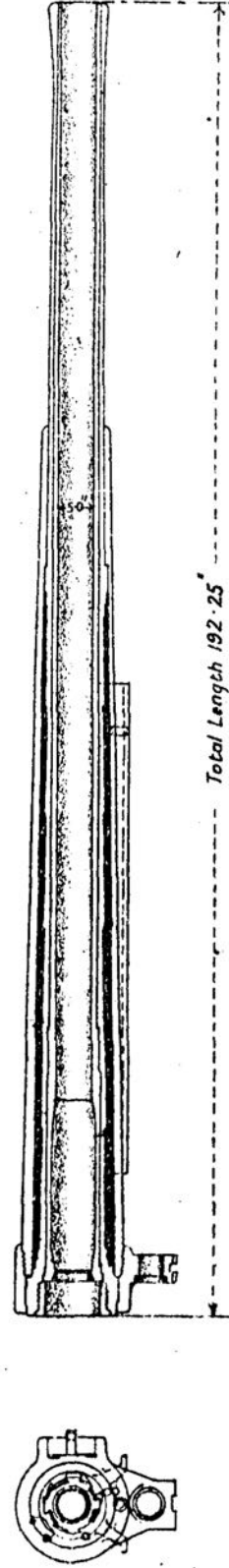
ORDNANCE, B.L. 60-PDR. MARK II.

SCALE $\frac{1}{28}$.



ORDNANCE, B.L. 60 PDR. MARK II.

SCALE $\frac{1}{28}$.

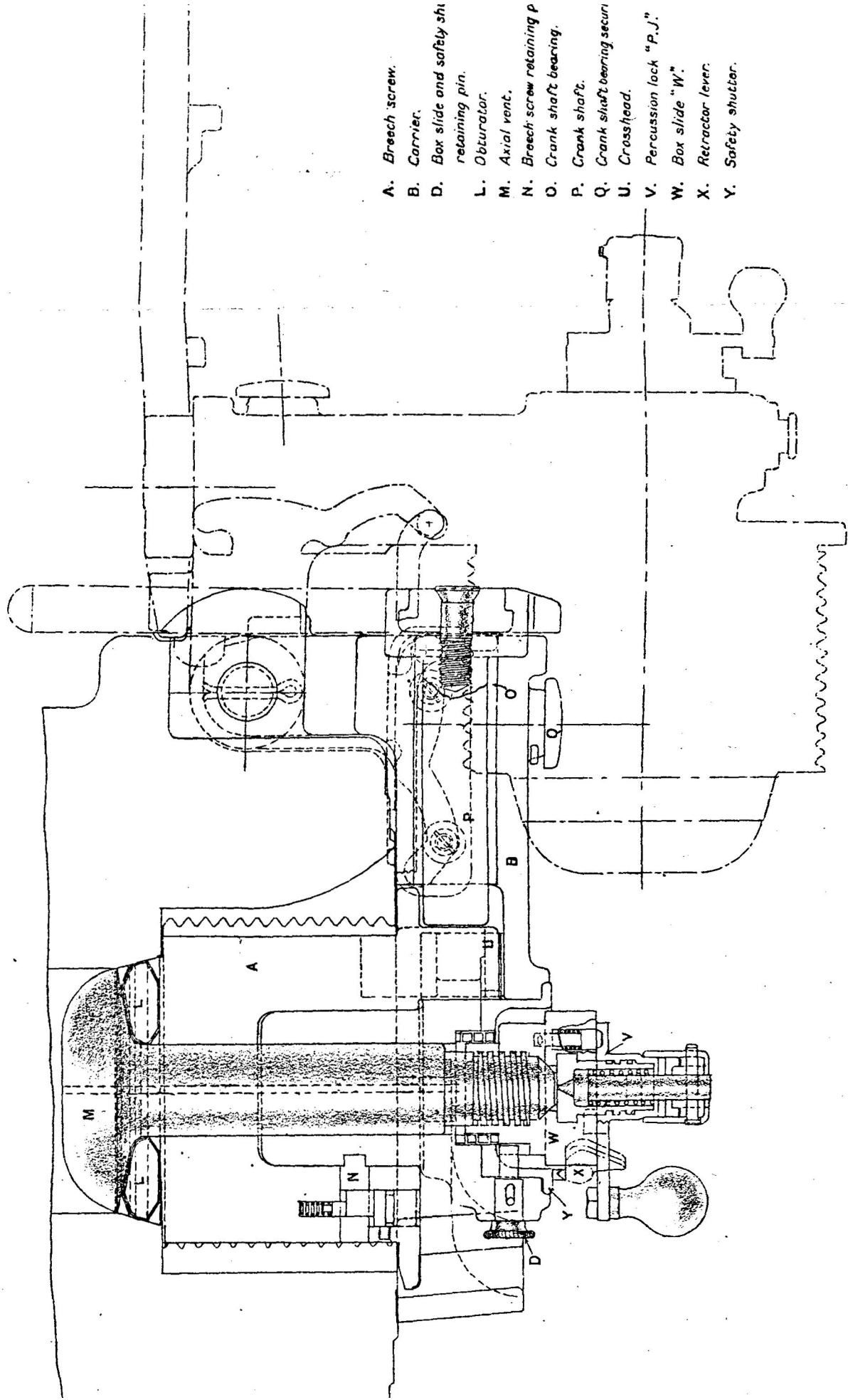


ORDNANCE, B.L. 60-PR MARKS II & II*.

GENERAL ARRANGEMENT OF BREECH MECHANISM.

SCALE $\frac{1}{8}$.

SECTIONAL PLAN.



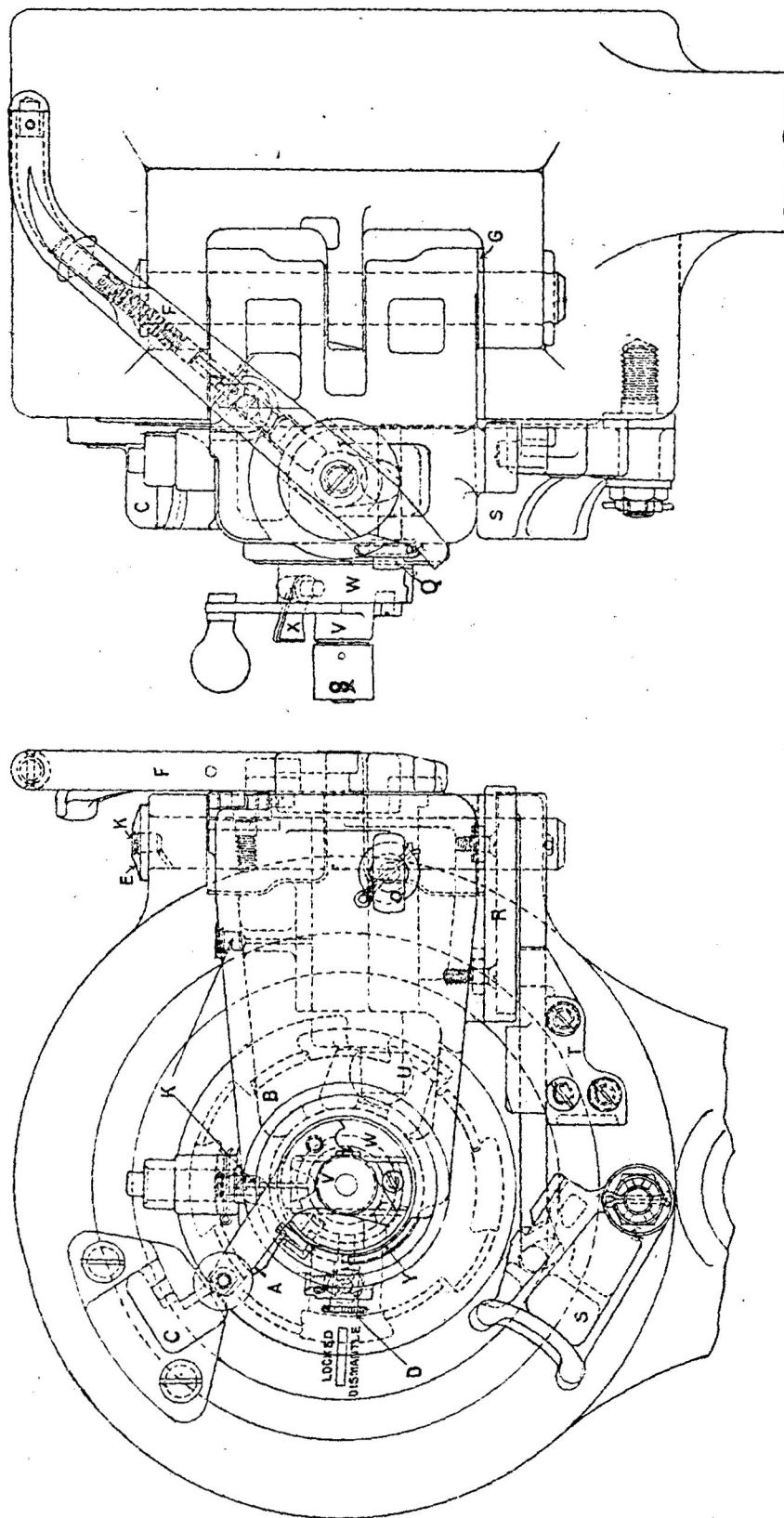
- A. Breech screw.
- B. Carrier.
- D. Box slide and safety shutter retaining pin.
- L. Obturator.
- M. Axial vent.
- N. Breech screw retaining pin.
- O. Crank shaft bearing.
- P. Crank shaft.
- Q. Crank shaft bearing securing crosshead.
- V. Percussion lock "P.J."
- W. Box slide "W."
- X. Retractor lever.
- Y. Safety shutter.

ORDNANCE, B.L. 60-P^R MARKS II & II*.

GENERAL ARRANGEMENT OF BREECH MECHANISM.

SCALE $\frac{1}{4}$.

ELEVATION

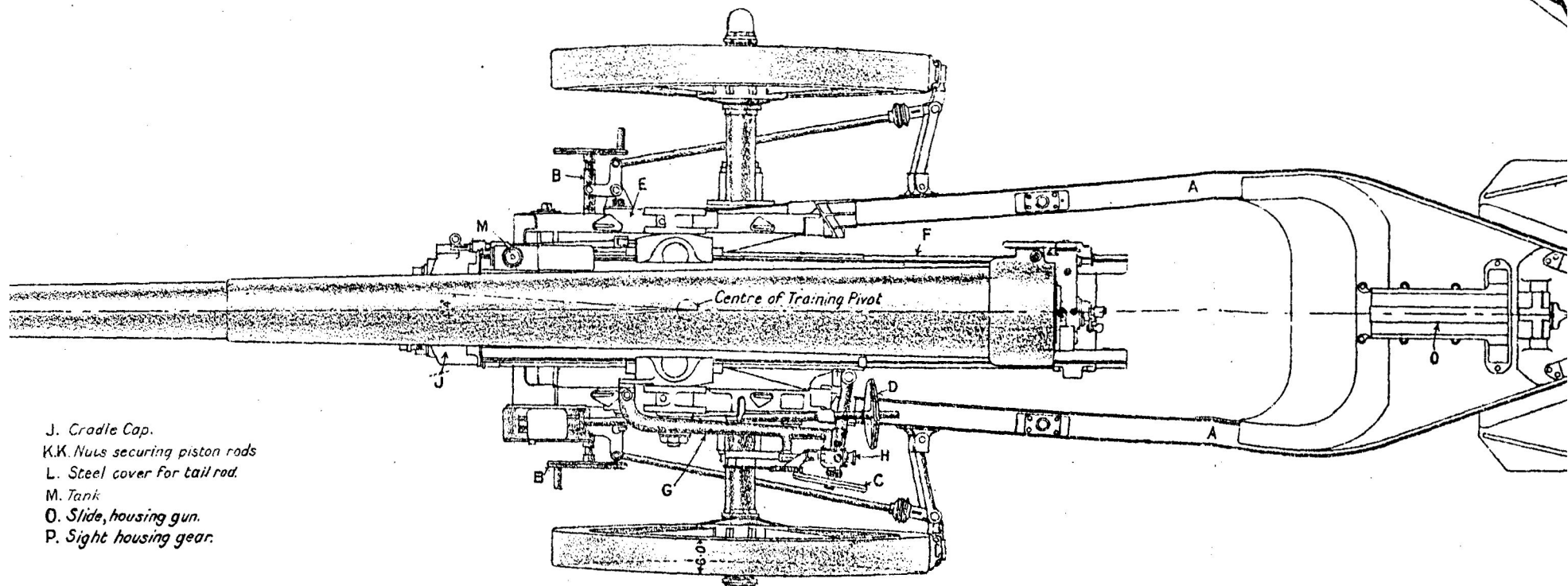
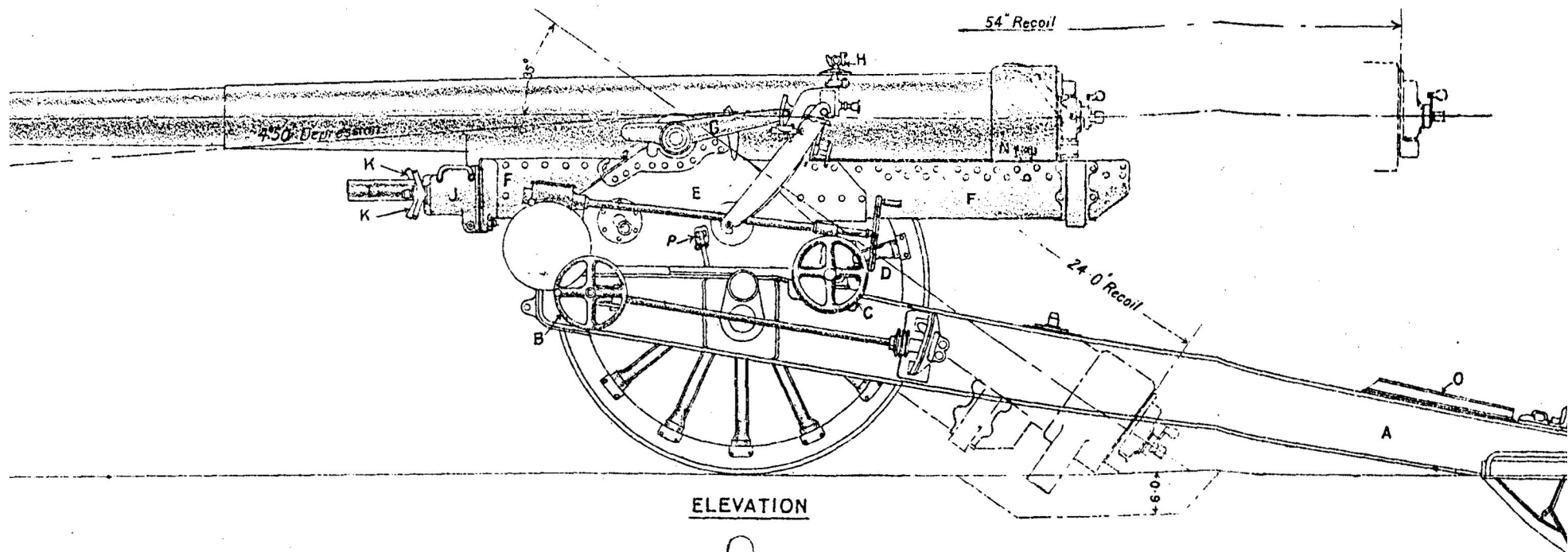


- | | |
|-------------------------------|--|
| A. Breech screw. | B. Carrier. |
| C. Rotating cam. | D. Box slide & safety shutter retaining pin. |
| E. Carrier hinge bolt. | F. Breech mechanism lever. |
| G. Bearing washer. | K. Lubricator No. 1 |
| R. Shot guide actuating plate | T. Shot guide actuating lever bracket. |
| S. Shot guide | V. Percussion lock "P.J." |
| U. Crosshead | X. Retractor lever. |
| W. Box slide "W" | |
| Y. Safety shutter. | |

CARRIAGE, FIELD, B.L. 60-P^R MARK IV.

GENERAL ARRANGEMENT.

SCALE $\frac{1}{24}$.



J. Cradle Cap.

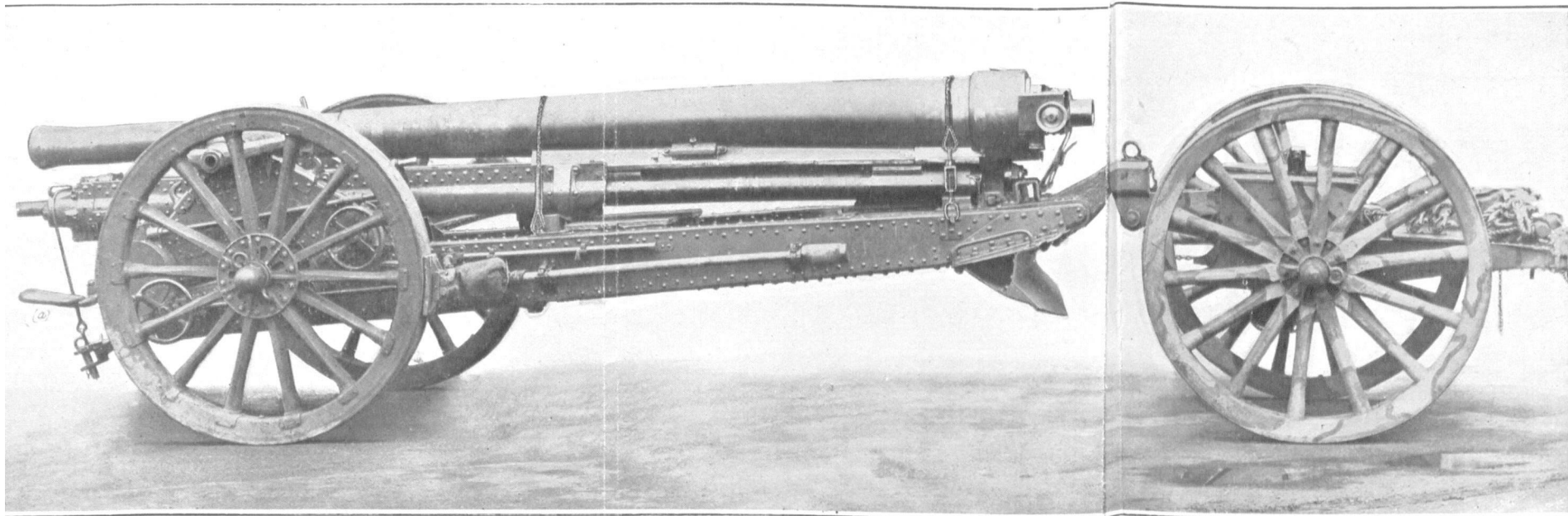
K.K. Nuts securing piston rods

L. Steel cover for tail rod.

M. Tank

O. Slide, housing gun.

P. Sight housing gear.

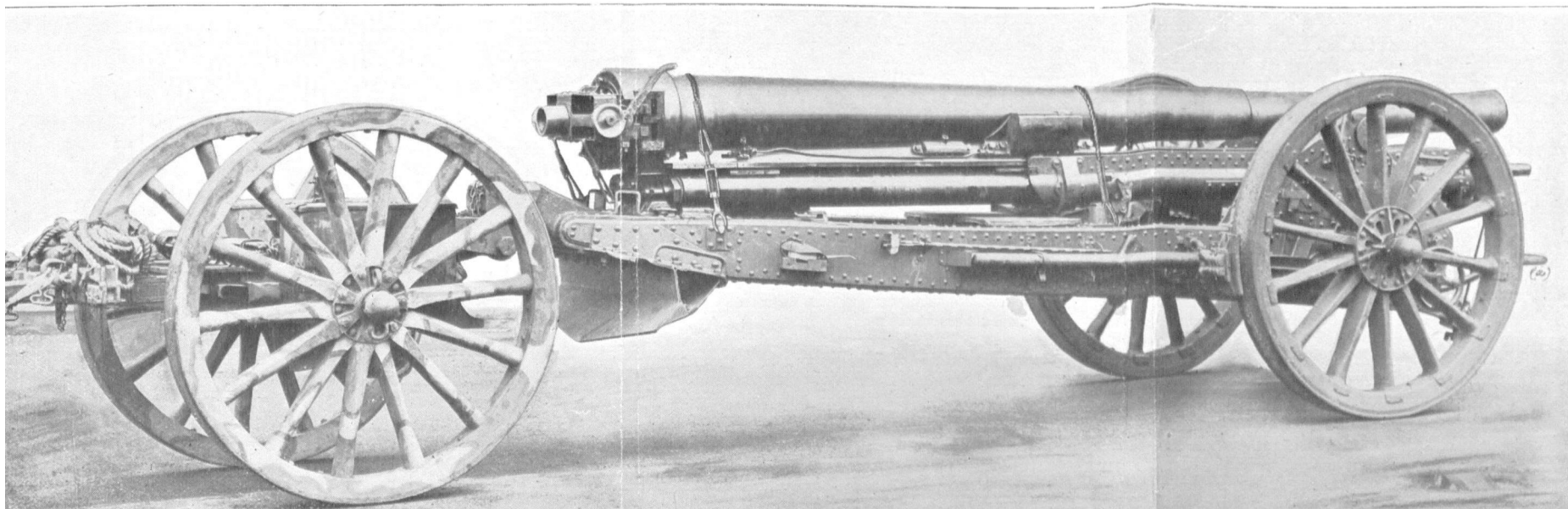


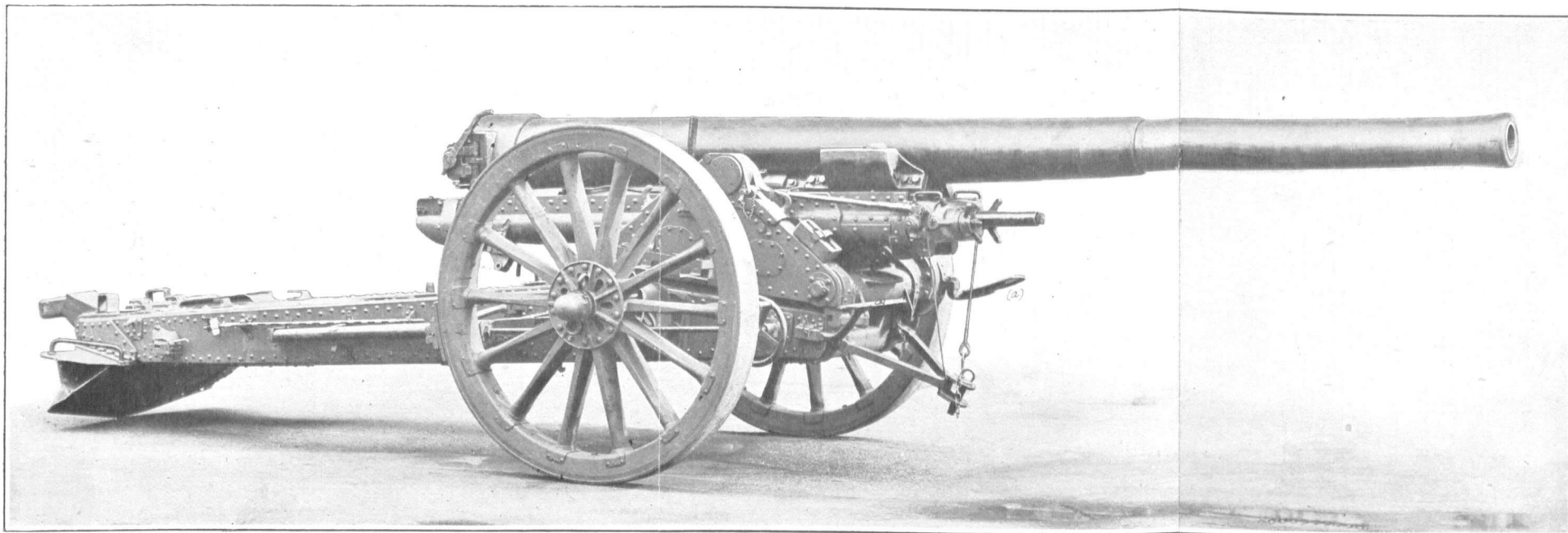
(a) Carriages of future manufacture will not be fitted with these seats.

CARRIAGE, FIELD, B.L. 60-PR., MARK IV.

Gun in travelling position.

Plate IV. b.



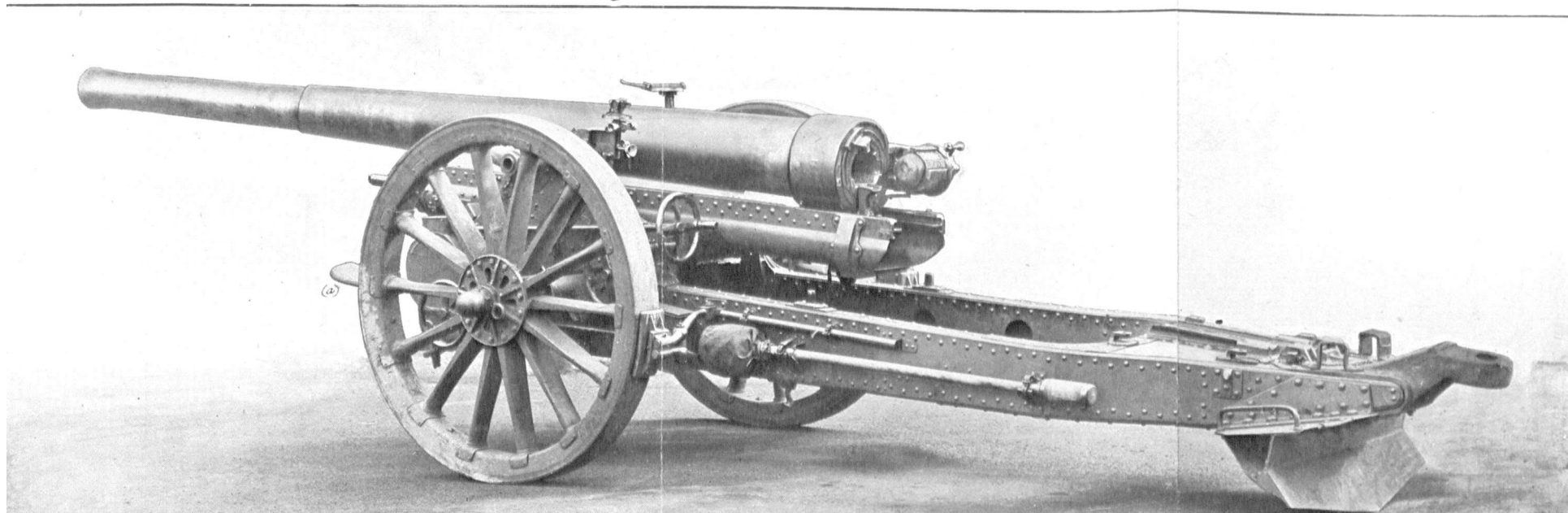


(a) Carriages of future manufacture will not be fitted with these seats.

CARRIAGE, FIELD, B.L. 60-PR., MARK IV.

Gun in firing position.

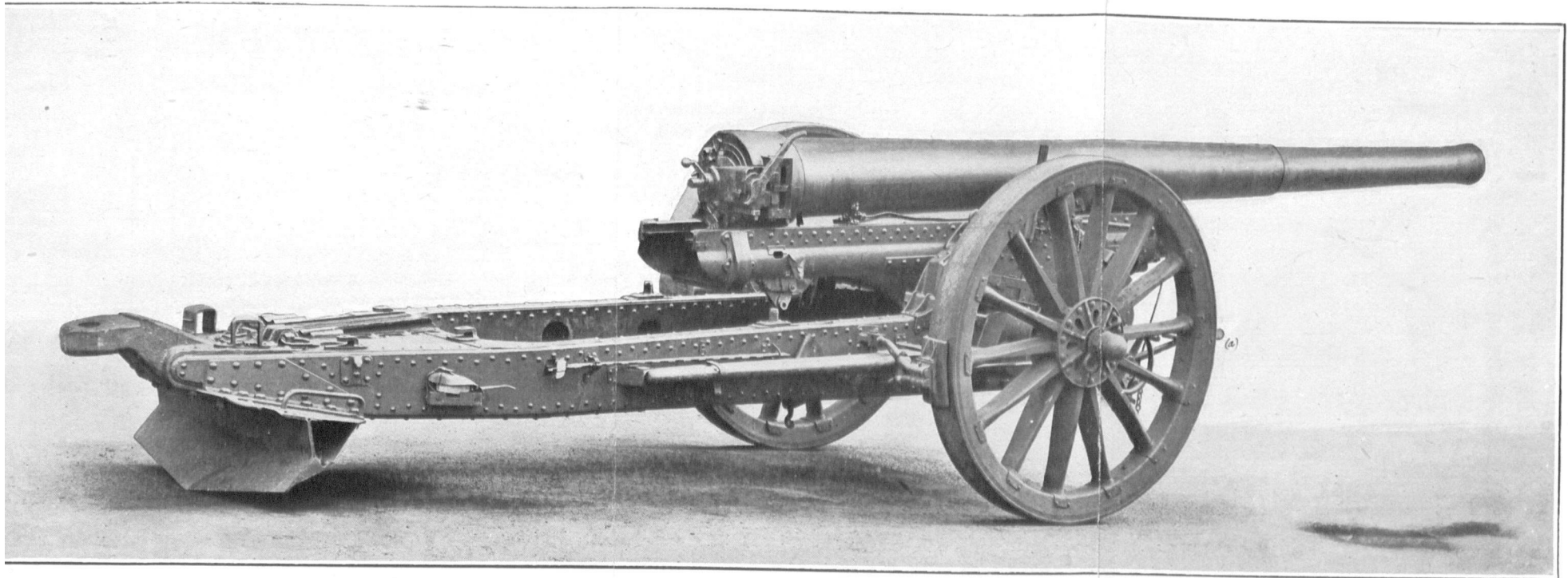
Plate IV. d.



CARRIAGE, FIELD, B.L. 60-PR., MARK IV.

Gun in firing position.

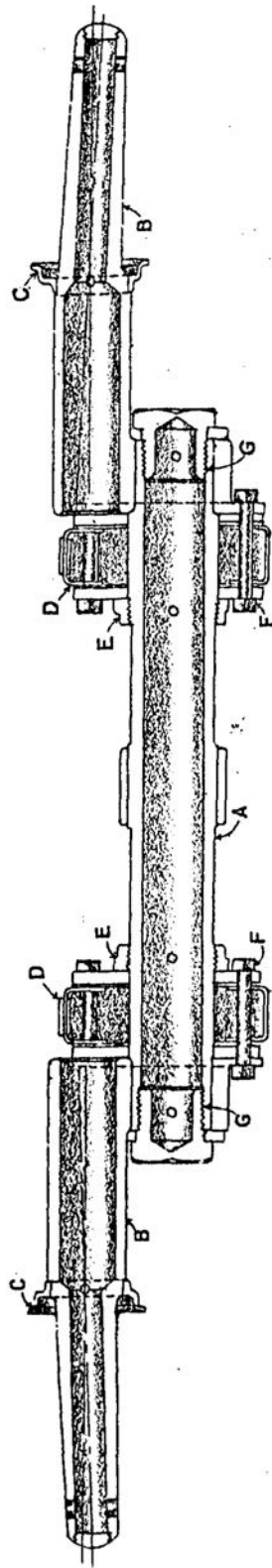
Plate IV. e.



(a) Carriages of future manufacture will not be fitted with these seats.

PUBLIC LIBRARY OF VICTORIA
CARRIAGE, FIELD, B.L. 60-PR., MARK IV.
 AXLE TREE 1ST. CLASS B, N^o 315.

SCALE $\frac{1}{2}$.

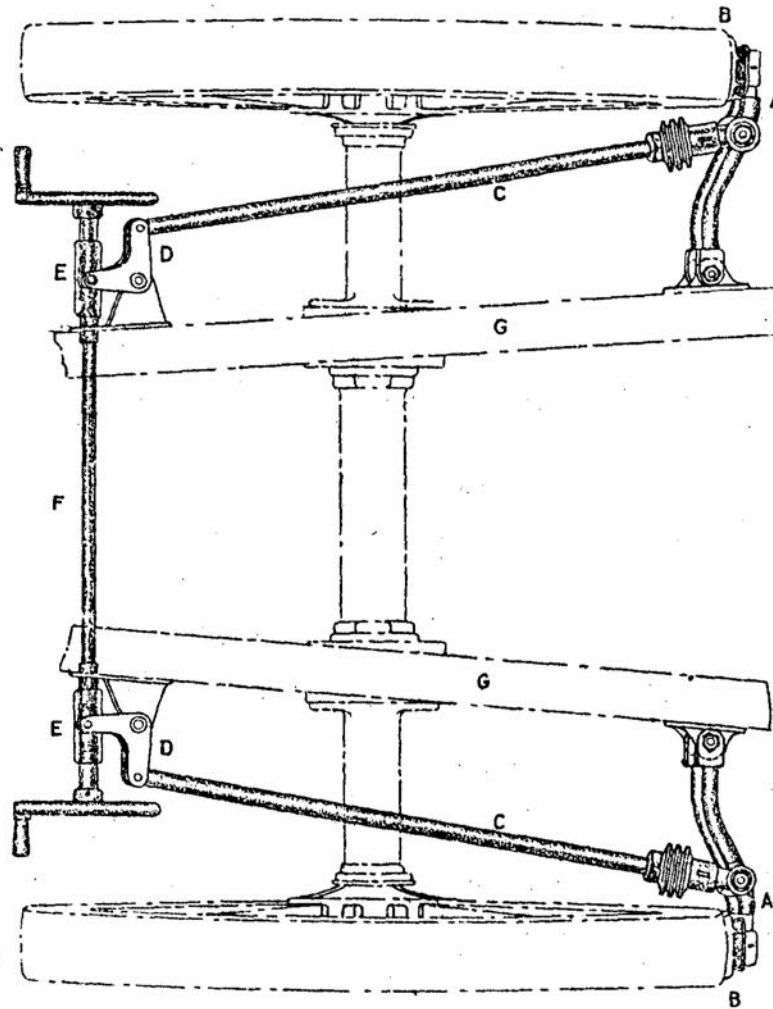


- A. Body.
- B. Arm.
- C. Dust excluder.
- D. Trail bracket.
- E. Secured collar.
- F. Securing bolt.
- G. Securing screw.

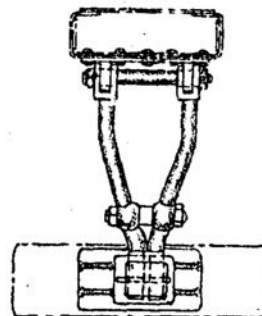
CARRIAGE, FIELD, B. L., 60-P^R, MARK IV.

ARRANGEMENT OF BRAKE GEAR.

SCALE $\frac{1}{16}$.

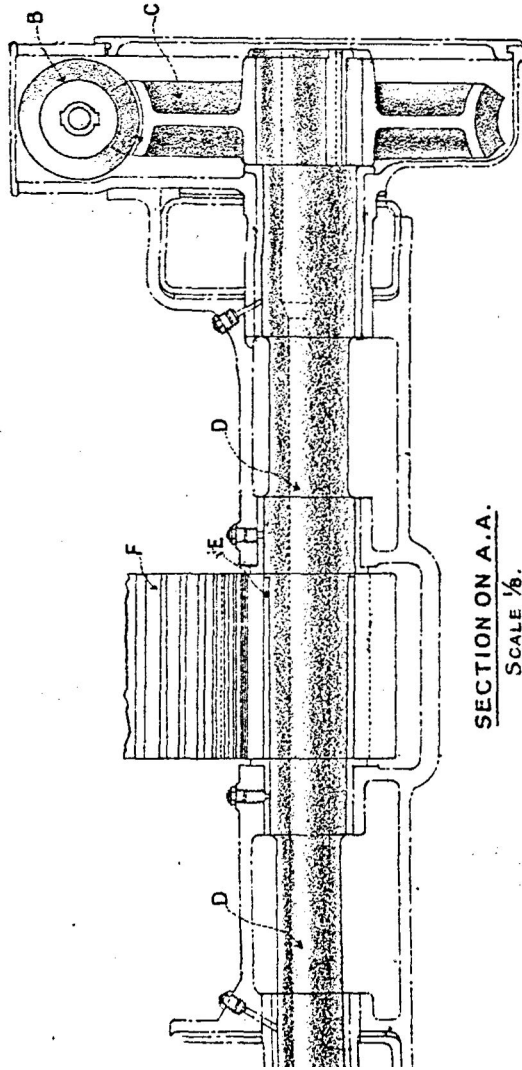
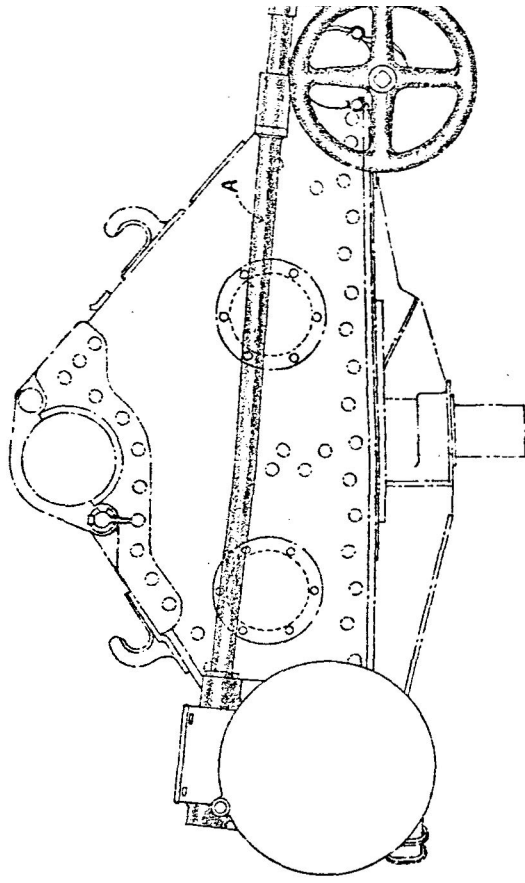


- A. Brake arm.
- B. Brake block.
- C. Actuating rod.
- D. Cranked levers
- E. Actuating nut.
- F. Actuating screw.
- G. Trail bracket.

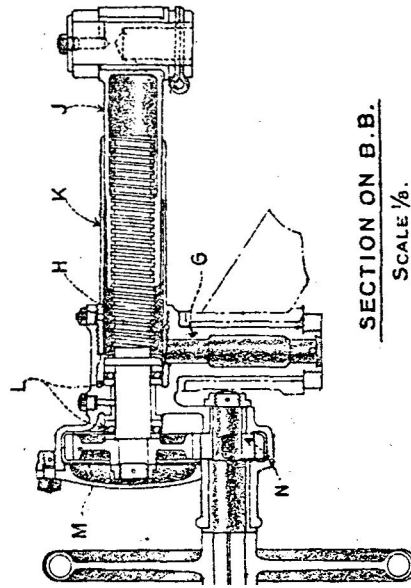


CARRIAGE, FIELD, B.L. 60-P.R. MARK IV.

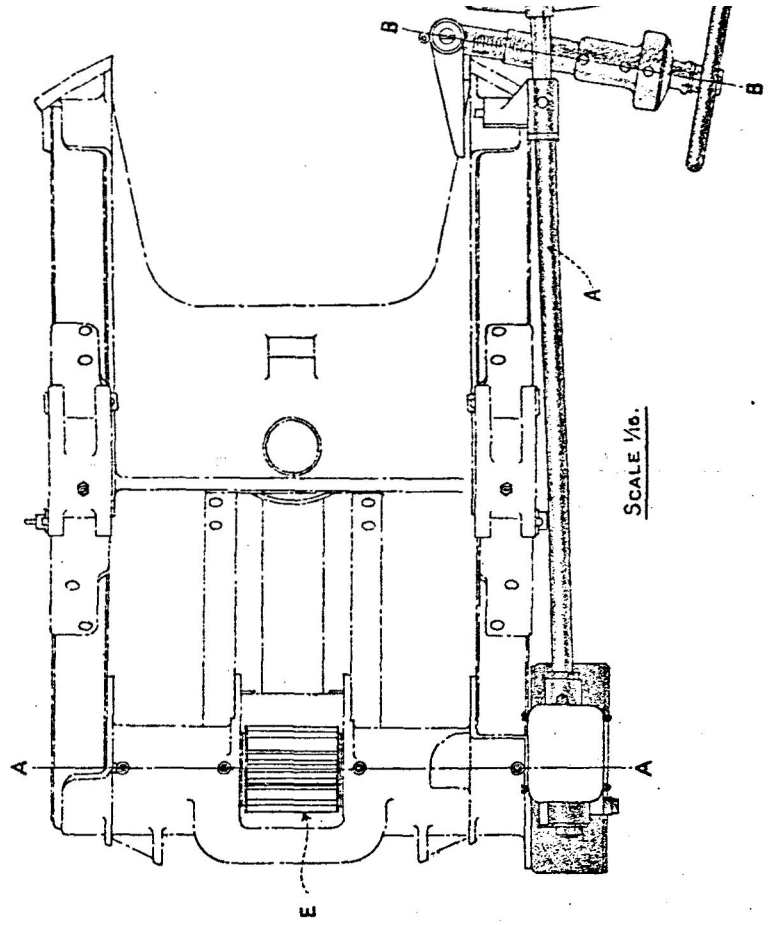
ARRANGEMENT OF ELEVATING & TRAVERSING GEARS.



SECTION ON A.A.
SCALE 1/16.



SECTION ON B.B.
SCALE 1/16.



SCALE 1/16.

ELEVATING GEAR.

- A. Worm shaft
- B. Worm
- C. Worm wheel
- D. Elevating shaft
- E. Elevating pinion
- F. Elevating arc

TRAVERSING GEAR.

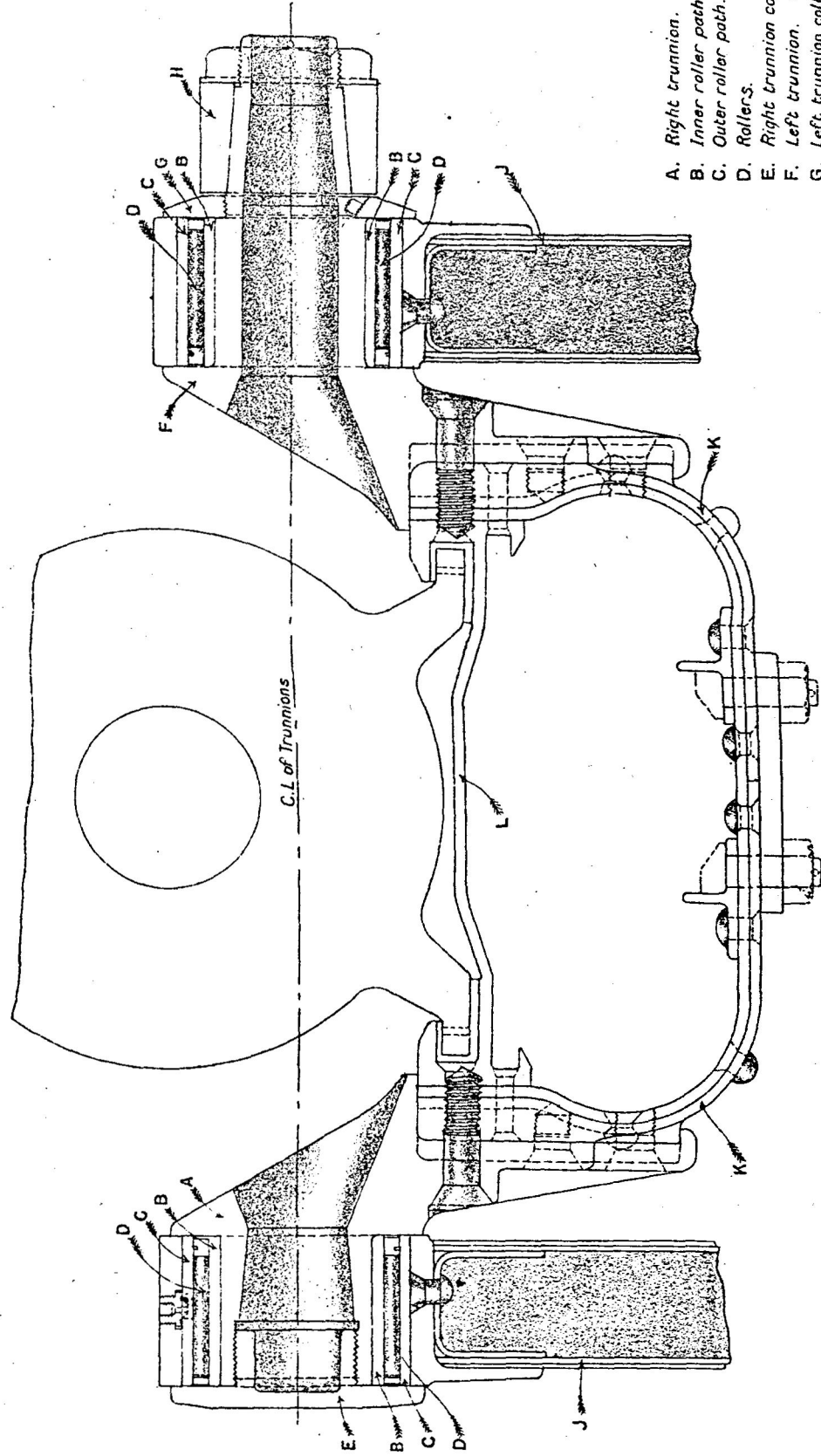
- G. M.B. Pivot
- H. Traversing screw
- J. Traversing nut
- K. Steel cover
- L. Ball bearings
- M. Spur wheel
- N. Pinion

CARRIAGE, FIELD, B.L. 60-P.R. MARK IV.

SECTION THRO' TRUNNIONS ETC.

VIEW LOOKING FROM FRONT TO REAR WITH CYLINDER BLOCK REMOVED.

SCALE $\frac{1}{5}$.

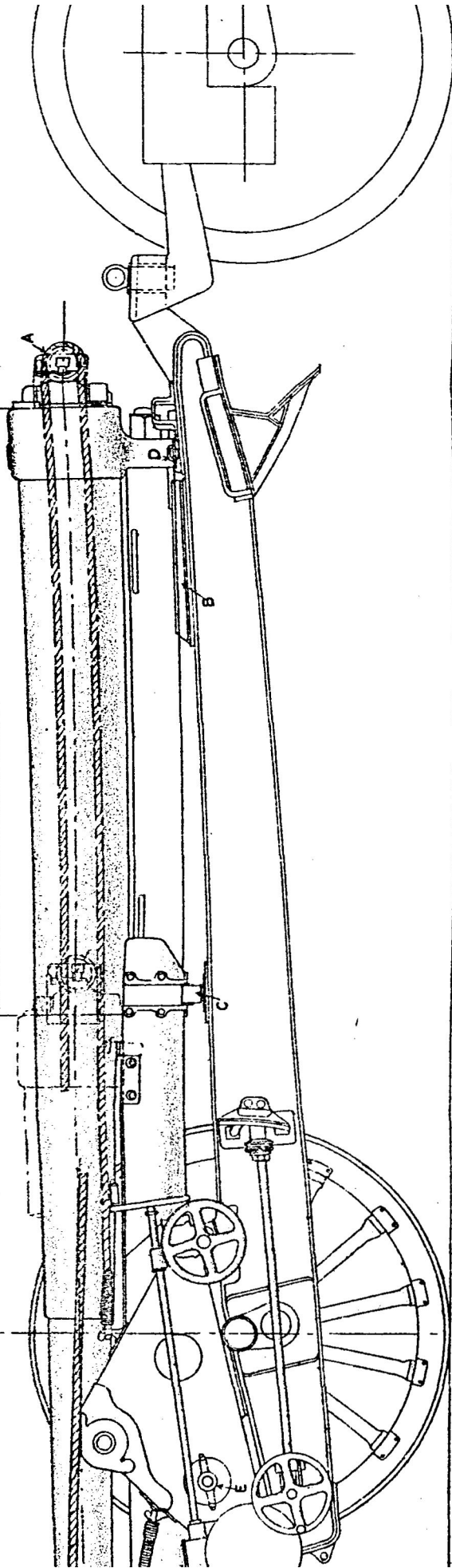


- A. Right trunnion.
- B. Inner roller path.
- C. Outer roller path.
- D. Roller-S.
- E. Right trunnion cap.
- F. Left trunnion.
- G. Left trunnion collar.
- H. Carrier for No 7 dial sight.
- J. Carriage side piece.
- K. Cradle with cylinder block removed.
- L. Cradle top plate.

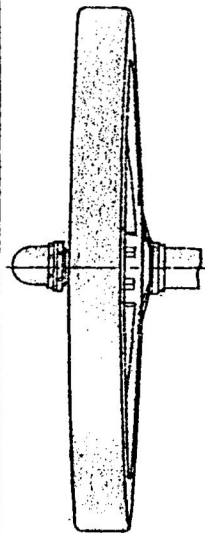
ARRANGEMENT OF HAULING OFF & ON ROPES.

SCALE ABOUT 1/22.

Hauled back 89.0 inches.

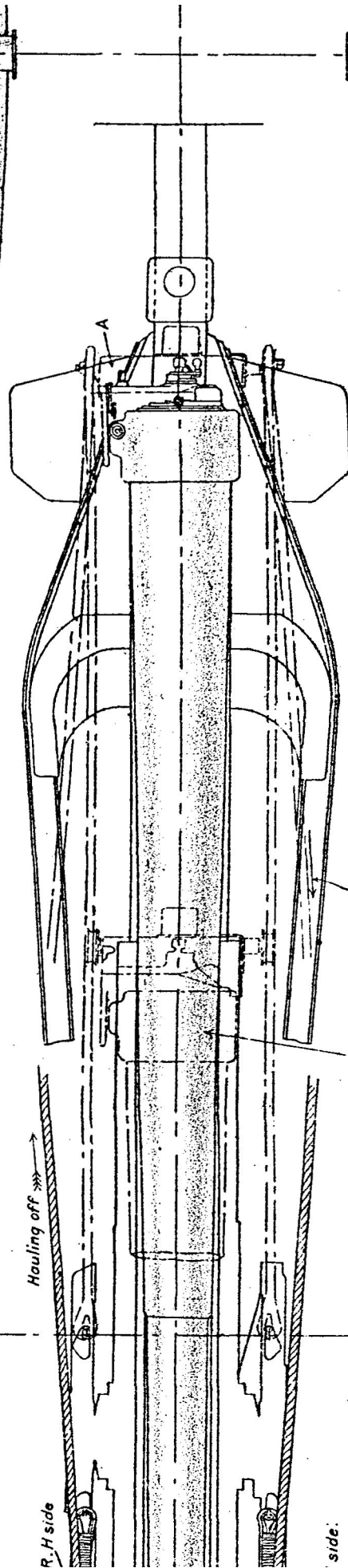


Gun shown hauled off in travelling position.
Position of Ropes for hauling off, shown in full lines.
" " " " on " " chain dotted lines.



Hauling off

R.H side

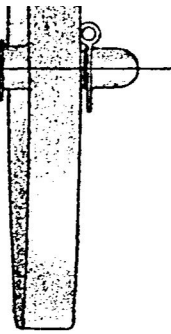


Hauling on

Position of Gun at start of Hauling off.

- A. Crosshead.
- B. Slide housing gun.
- C. Bar supporting cradle.
- D. Locking pin.

side.

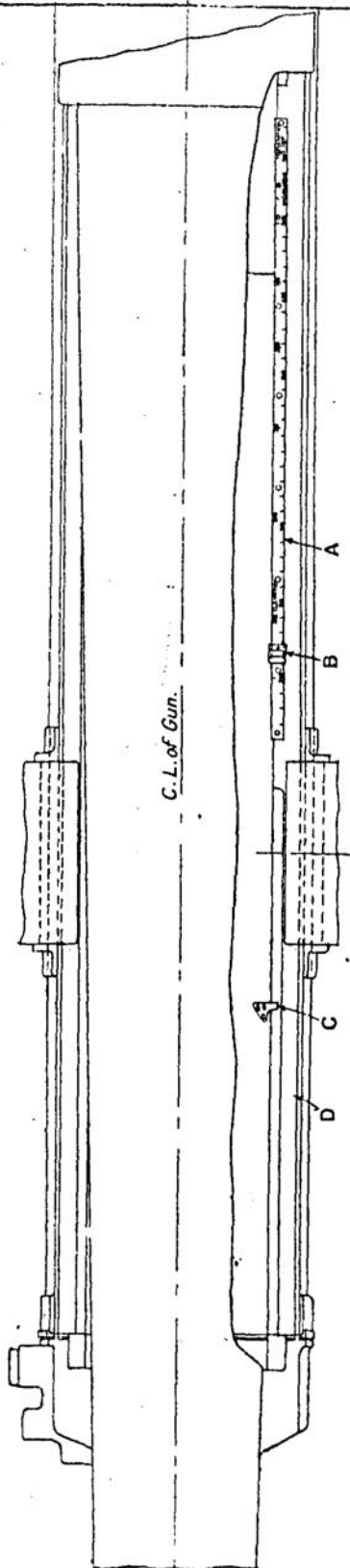


CARRIAGE, FIELD, B.L., 60-PDR MARK IV.

ARRANGEMENT OF RECOIL INDICATOR.

SCALE— $\frac{1}{2}$.

PLAN



- A. Graduated Strip.
- B. Slider.
- C. Bracket.
- D. Cradle.

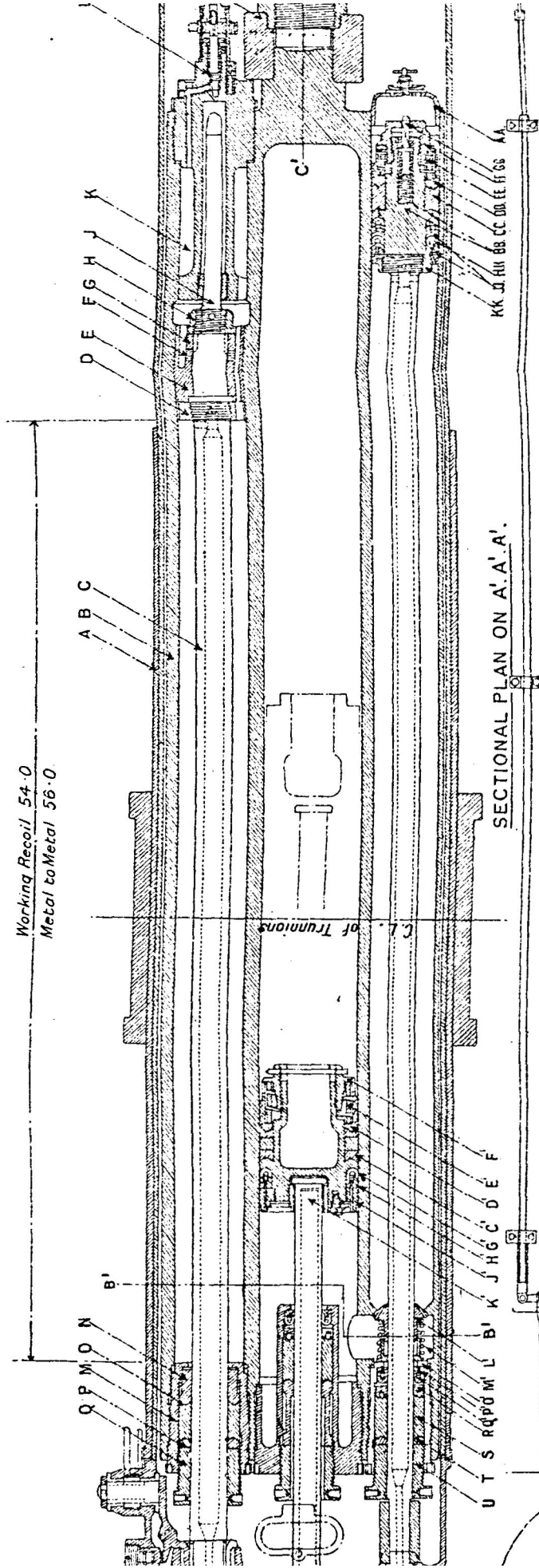
Plate X

H. & C. CORHAM UP LITHO LONDON, S.E.

CARRIAGE, FIELD, B.L. 60-P. MARK IV.

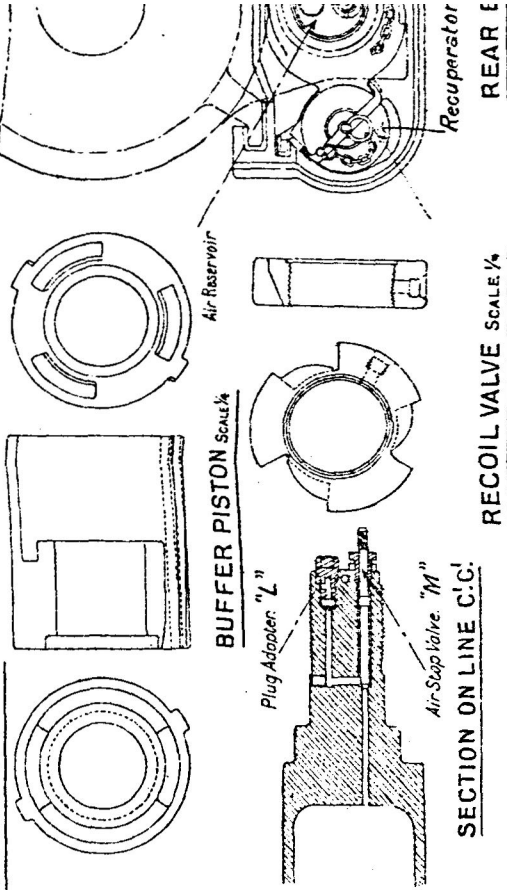
GENERAL ARRANGEMENT OF BUFFER AND RECUPERATOR.

SCALE ABOUT 1/8.



SECTIONAL PLAN ON A'A'.

VIEW OF SNIFFING VALVE AND SPINDLE.



RECOIL VALVE SCALE 1/4.

SECTION ON LINE C'C'.

BUFFER

- A. Cradle.
- B. Cylinder Block.
- C. Piston Rod.
- D. Recoil Valve.
- E. Piston.
- F. Washers.
- G. Steel Collar.
- H. Securing Nut.
- J. Control Plunger.
- K. Rear Closing Plug.
- L. Adjusting Valve.
- M. Stuffing Box.
- N. Supporting Ring.
- O. Dicks' Packing.
- P. Supporting Ring.
- Q. Gland.

AIR RESERVOIR.

- A' Nut Securing Gun.
- B' Gun Lug.
- C' Lion Packing.
- D' Supporting Ring.
- E' Spiral Spring.
- F' Nut.
- G' U' Rubber.
- H' Supporting Ring.
- J' Securing Nut.
- K' Tail Rod.

RECUPERATOR.

- AA. Dust Cover.
- BB. Piston Head.
- CC. Lion Packing.
- DD. Supporting Ring.
- EE. Spiral Spring.
- FF. Cap.
- GG. Plunger.
- HH. U' Rubbers.
- JJ. Supporting Rings.
- KK. Collar.
- L' Retarding Valve.
- M' " " Spring.
- N' Non Return Valve.
- O' Stuffing Box.
- P' Supporting Ring.
- Q' U' Rubbers.
- R' Securing Ring.
- S' Dicks' Packing.
- T' Supporting Ring.
- U' Gland.

SECTION ON LINE B'B'.

VIEW.

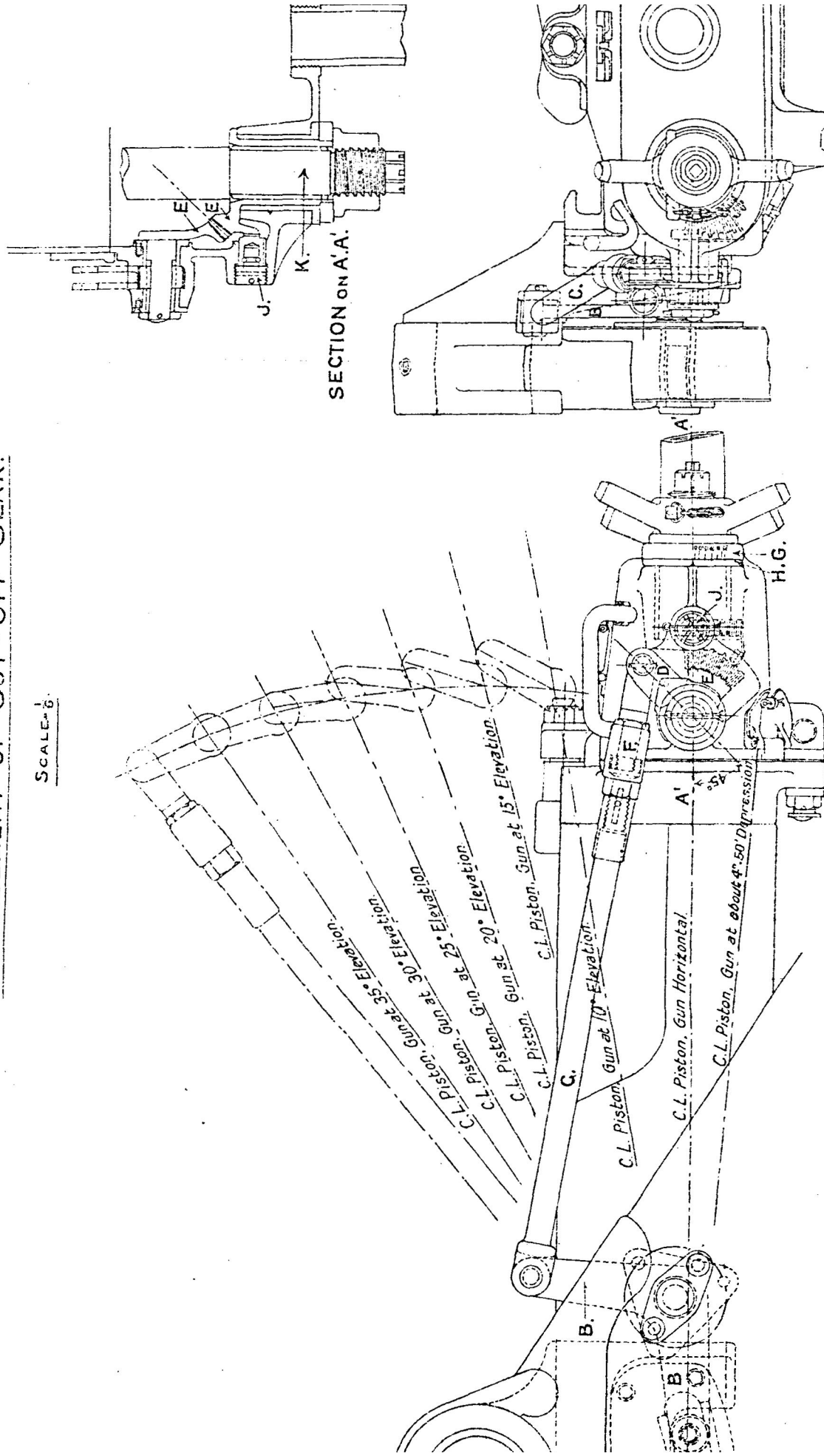
REMOVED.

Note - In future manufacture the spring compressing packing, Floating piston, will be omitted.

CARRIAGE, FIELD, B.L. 60-PDR. MARK IV.

ARRANGEMENT OF CUT-OFF GEAR.

SCALE - $\frac{1}{8}$.



RIGHT SIDE ELEVATION.

FRONT VIEW.

ink.
over
vents.

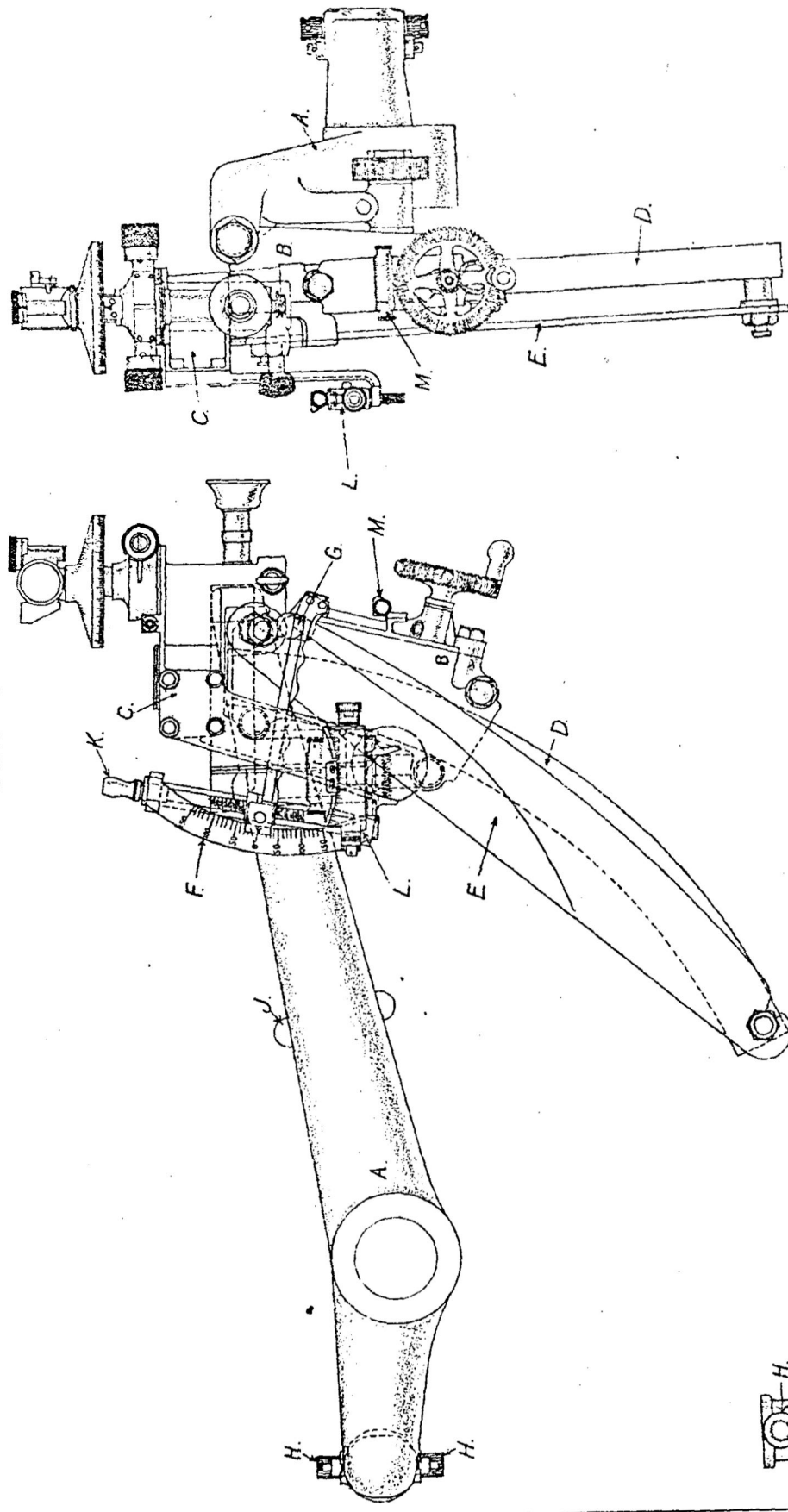
usa.
d/e.

CARRIAGE FIELD. B.L. 60-PDR. MARK IV.

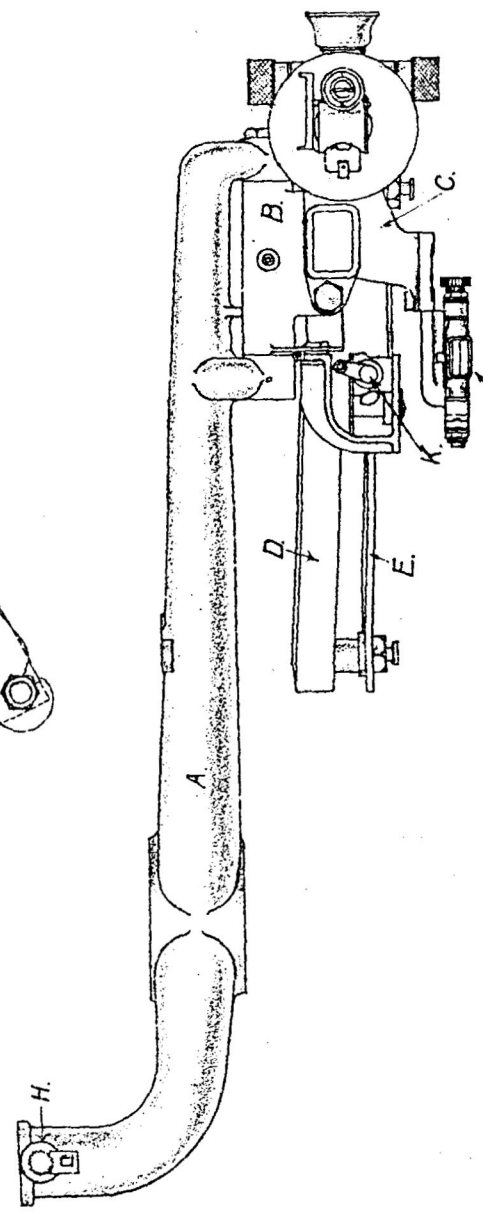
GENERAL ARRANGEMENT OF SIGHTING GEAR.

CONSISTING OF N° 9 CARRIER, SIGHT CLINOMETER, AND N° 7 DIAL SIGHT.

SCALE 1/6.

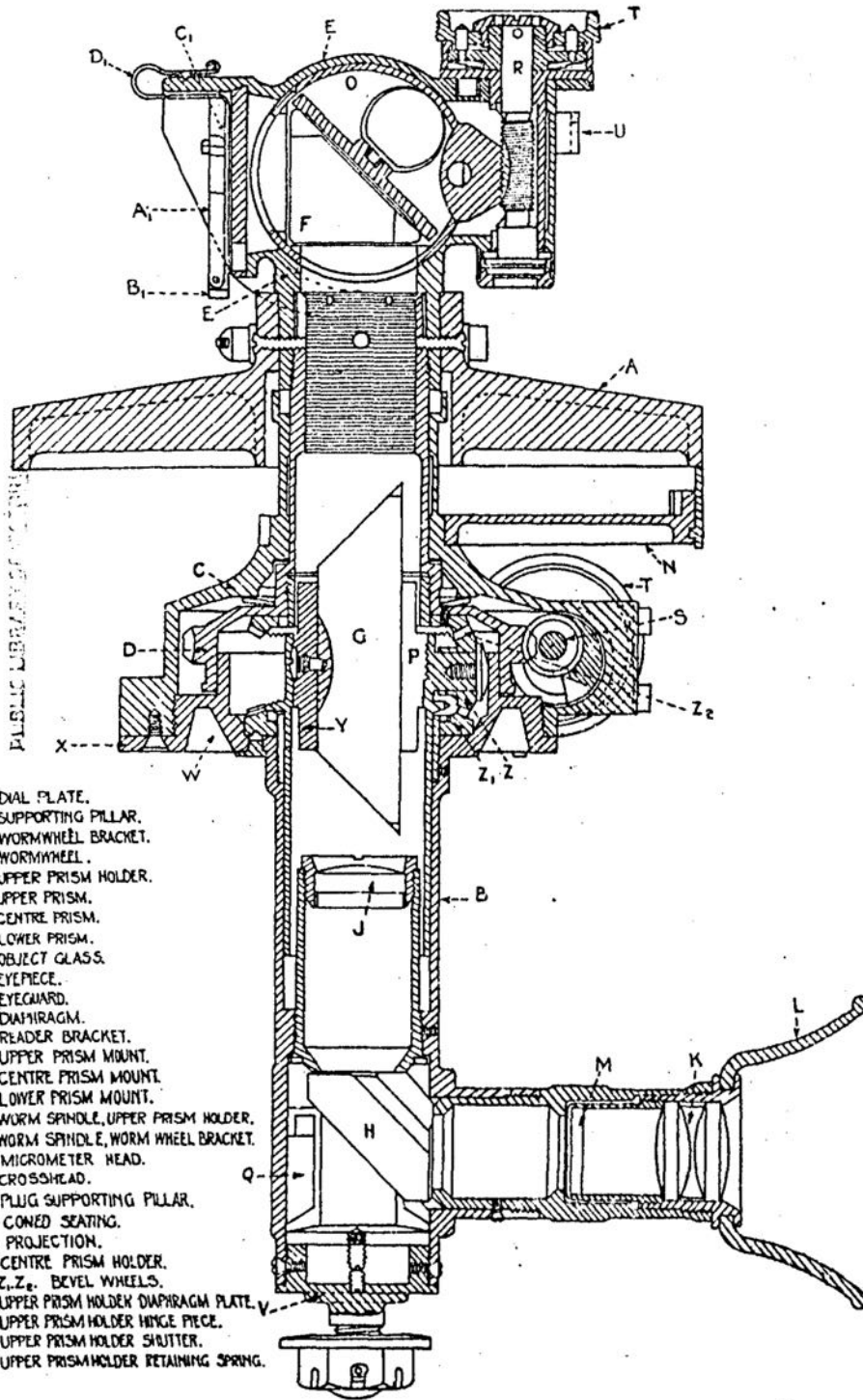


- A. Supporting Bracket.
- B. Elevating Arc Bracket.
- C. Sight Socket Bracket.
- D. Elevating Arc.
- E. Elevation Scale Plate.
- F. M.V. Scale.
- G. Reader Bar.
- H. Adjusting Screws.
- J. Elevation Indicator.
- K. Key, Actuating Reader Bar.
- L. Sight Clinometer.
- M. Cross Levelling Bubble.



SIGHT, DIAL, N° 7, MARK III.

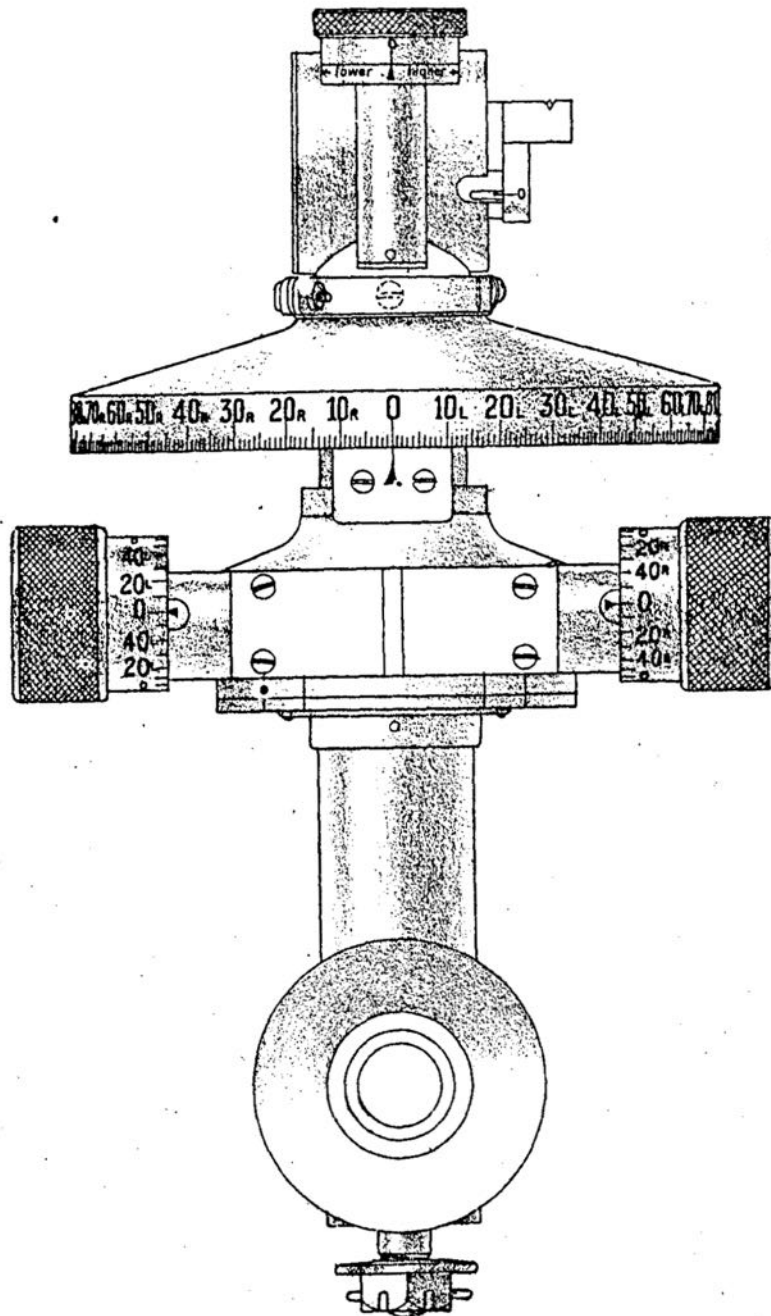
SCALE = $\frac{3}{4}$.



- A. DIAL PLATE.
- B. SUPPORTING PILLAR.
- C. WORMWHEEL BRACKET.
- D. WORMWHEEL.
- E. UPPER PRISM HOLDER.
- F. UPPER PRISM.
- G. CENTRE PRISM.
- H. LOWER PRISM.
- J. OBJECT GLASS.
- K. EYEPiece.
- L. EYEGUARD.
- M. DIAPHRAGM.
- N. READER BRACKET.
- O. UPPER PRISM MOUNT.
- P. CENTRE PRISM MOUNT.
- Q. LOWER PRISM MOUNT.
- R. WORM SPINDLE, UPPER PRISM HOLDER.
- S. WORM SPINDLE, WORM WHEEL BRACKET.
- T. MICROMETER HEAD.
- U. CROSSHEAD.
- V. PLUG SUPPORTING PILLAR.
- W. CONED SEATING.
- X. PROJECTION.
- Y. CENTRE PRISM HOLDER.
- Z, Z1, Z2. BEVEL WHEELS.
- A. UPPER PRISM HOLDER DIAPHRAGM PLATE.
- B. UPPER PRISM HOLDER HINGE PIECE.
- C. UPPER PRISM HOLDER SHUTTER.
- D. UPPER PRISM HOLDER RETAINING SPRING.

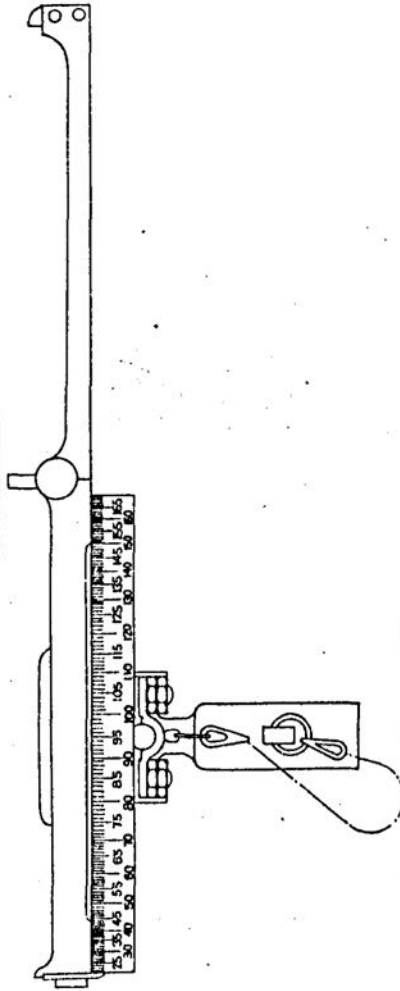
SIGHT, DIAL. N° 7. MARK III.
SHOWING MARKING FOR FUTURE MANUFACTURE.

SCALE $\frac{2}{3}$.

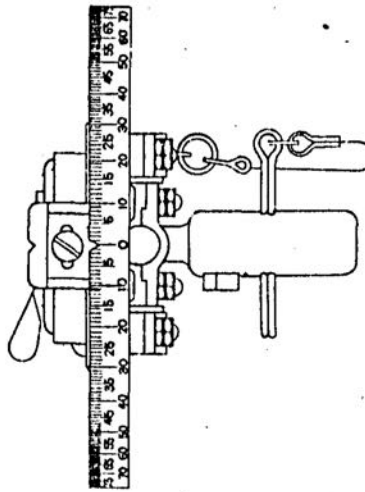


SIGHT DIAL N^o I. MARK II.

SCALE = $\frac{1}{3}$



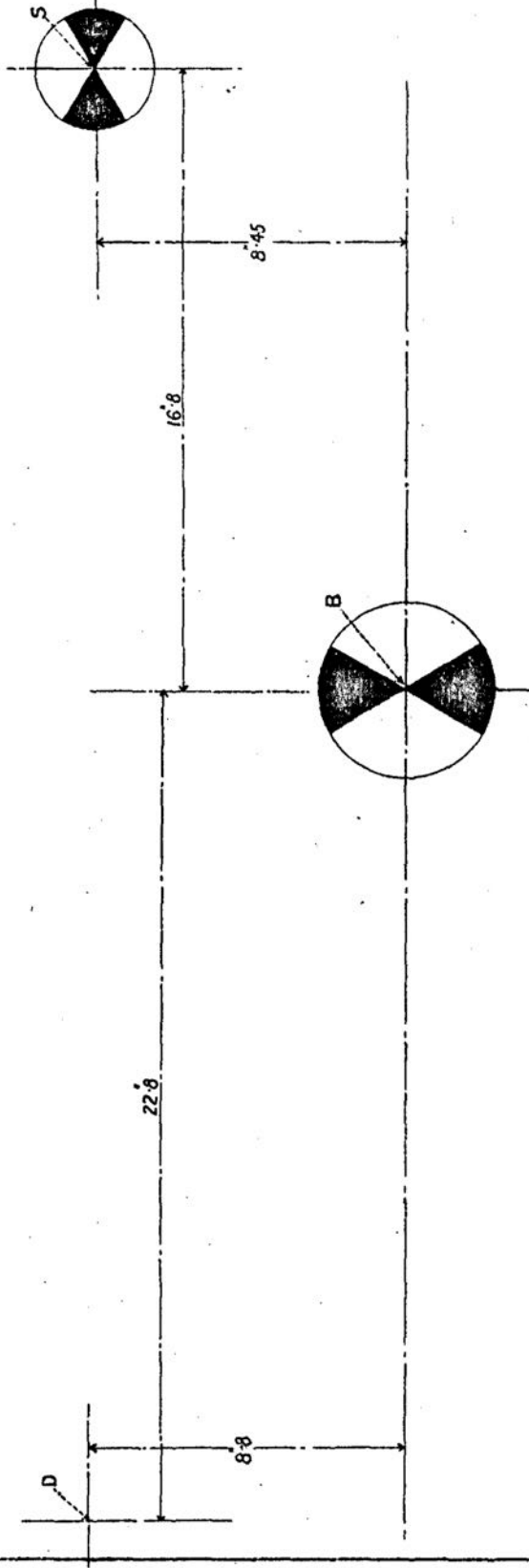
SIDE ELEVATION.



REAR ELEVATION.

TARGET FOR TESTING SIGHTS. B.L. 60 P. M. IV.

SCALE $\frac{1}{5}$.



B. Bore.
D. No. 7, Dial Sight.
S. No. 1.

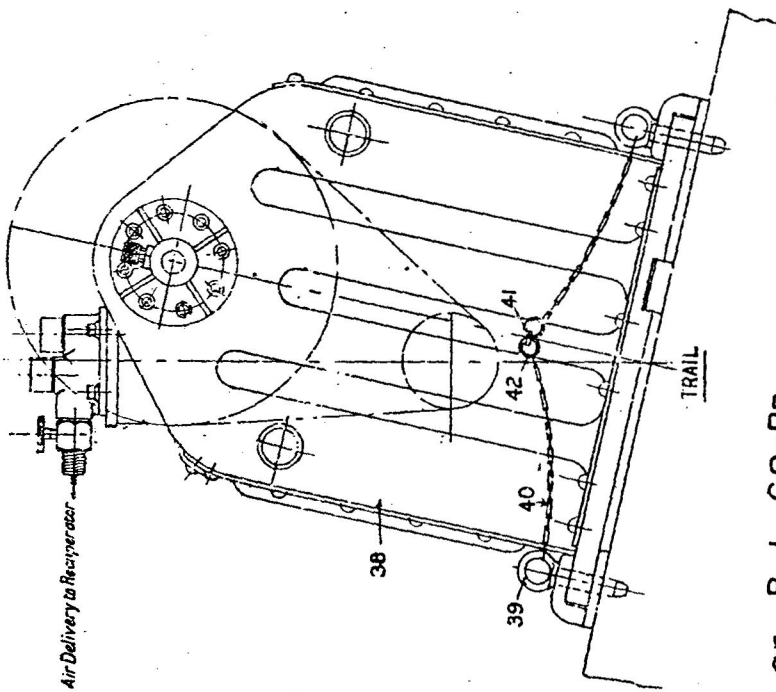
VIEW SHOWING NO. 2. VERTICAL TWO-STAGE AIR-PUMP.

The drawing consists of two parts. The upper part is a cross-sectional view of the pump body, showing two stages of compression. The lower part is a side view of the internal mechanism, showing the pistons, valves, and the delivery and suction ports. The drawing is labeled with various numbers (1-37) and includes the text 'Delivery' and 'Suction'.

NOTE For replacement purposes the various Components should be demanded under the following NOMENCLATURE.

<u>Code Word.</u>		<u>Code Word.</u>	<u>Code Word.</u>	<u>Code Word.</u>	
1 Pedestal	Vicpedest.	10 Gudgeon Pin	Vicuqpin.	19 Delivery Valve Cap	Vicdelcap.
2 Cylinder	Vicycl.	11 L.P.Junk Plate	Viclplate.	20 " " Plug	Vicdelplug.
3 Liner.	Vicliner.	12 L.P.Packing Rings	Viclowpack.	21 " " Seat	Vicdelseat.
4 Piston.	Viciston.	13 H.P.Packing Rings	Vichipack.	22 " Valve	Vicdeval.
5 Crankshaft	Vichaft.	14 H.P.Junk Ring.	Vichijunk.	23 " Spring	Vicdearing.
6 Eccentric Strap.	Vicheatric.	15 Suction Valve Cap.	Vicescap.	24 Suction Valve Spring	Vicespring.
7 Eccentric Sheave	Vicheave.	16 " " Plug	Vicesplug.	25 Washer.	Vicwasher.
8 Flywheel.	Vieweel.	17 " " Seal	Viceseat.	26 Drip Lubricator.†	Viculubr.
9 Cylinder	Vicever.	18 " " Valve	Vicsvalve.	27 " Union & Pipe	Viclupeipe

This technical drawing illustrates a mechanical assembly, possibly a pump or engine component, shown in a cross-sectional and side-view perspective. The assembly features a central circular component, likely a piston or a valve, which is surrounded by a complex housing or frame. The drawing includes numerous numbered callouts (1 through 57) identifying specific parts and components. Key features include a central shaft or rod (1) passing through the assembly, a large circular opening (2) in the housing, and various bolts, nuts, and seals (e.g., 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57). A detailed view of the central circular component is provided, showing internal structures and a central hole. The drawing is a black and white line drawing, typical of technical specifications.

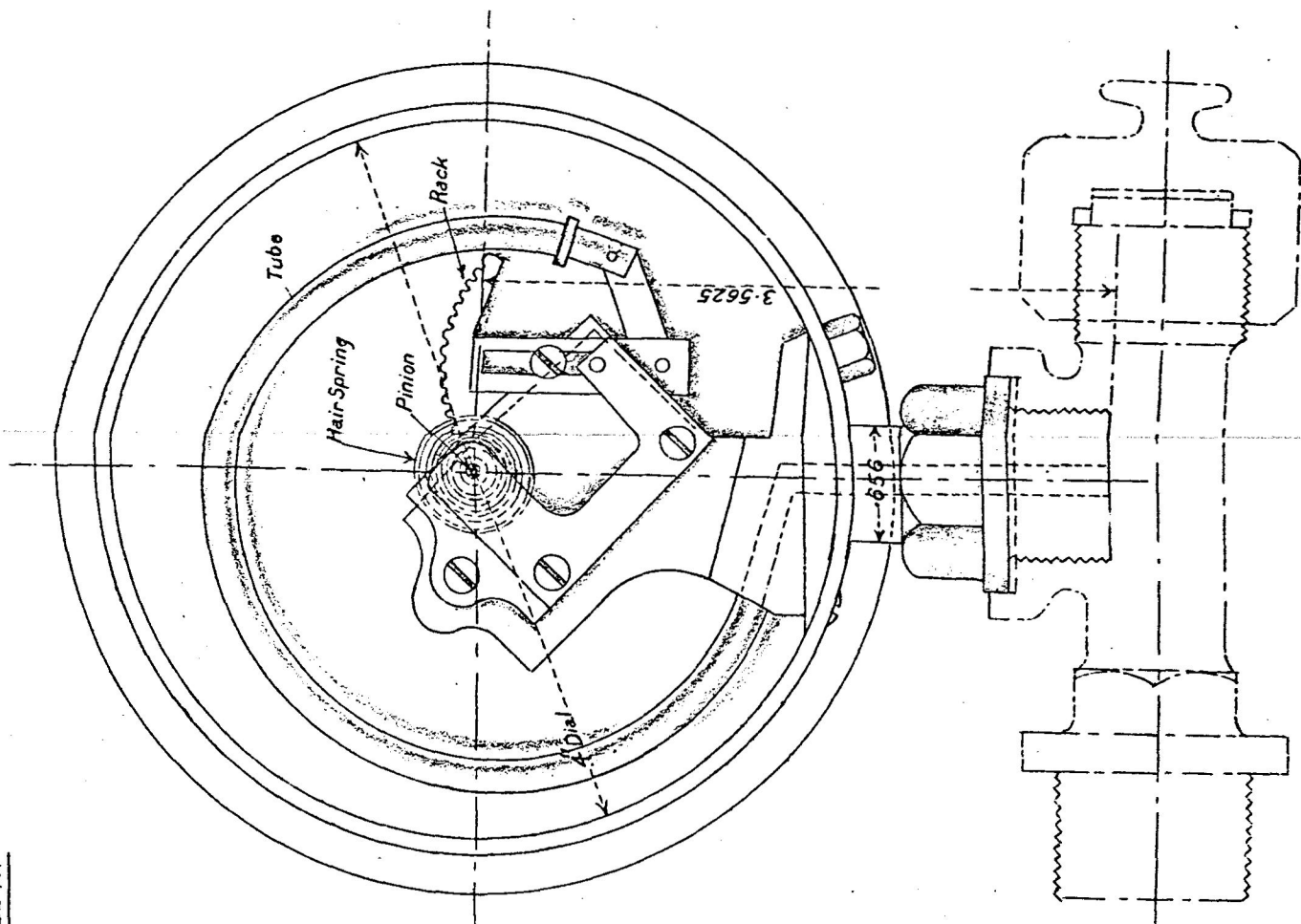
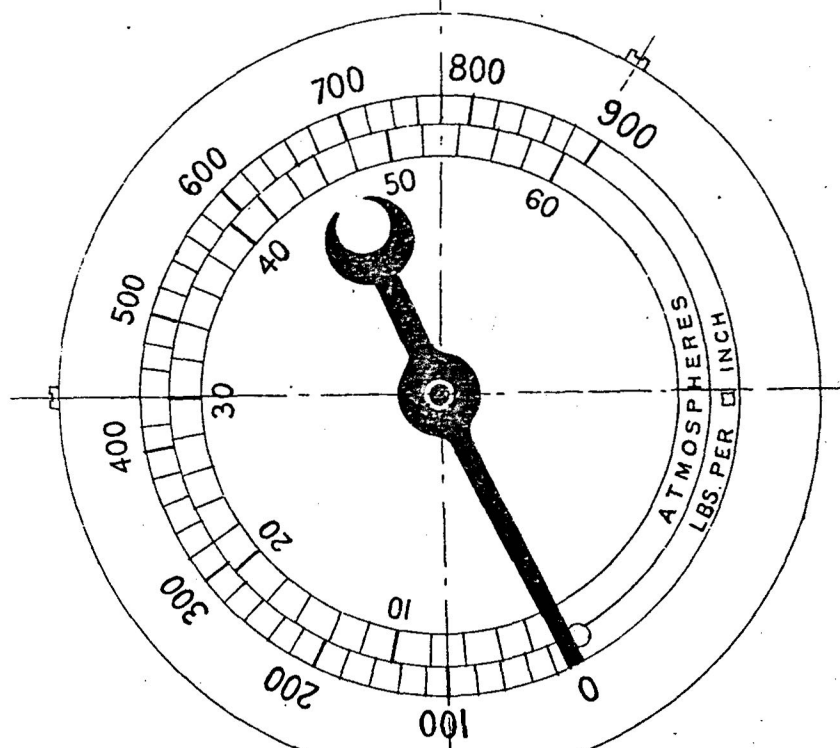


NOTE For replacement purposes the various Components should be demanded under the following NOMENCLATURE.

<u>Code Word</u>		<u>Code Word</u>
38 Housing.	45 Handle Lock Nut.	Haulock.
39 Dowel Pin.	46 Lock Nut Washer.	Haucap.
40 " Chain.	47 Handle Nut.	Havnut.
41 Eye Bolt.	48 Crank.	Houcrank.
42 " Ring.	49 Split Pin.	Hauptin.
43 Brass Tube for Handle.	50 Lubricator.	Haulub.
44 Handle.	51 Shaft.	Hauspind.

GAUGE, PRESSURE, N°5, MARK I.

SCALE $\frac{1}{2}$.

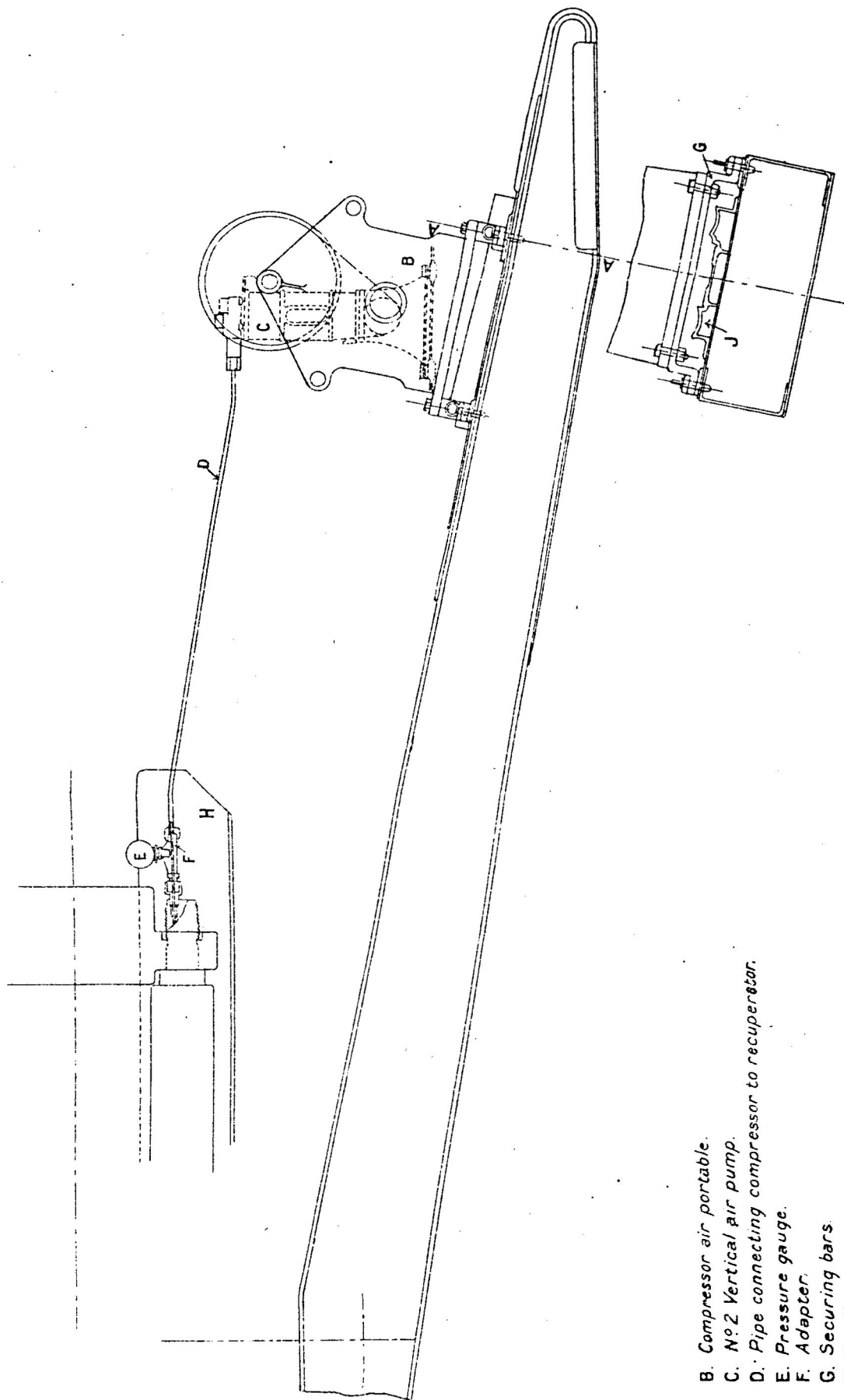


Graduations for pressures to be marked in Red.
See Para 18093 List of Changes.

CARRIAGE, FIELD, B.L. 60 PR. MARK IV.

ARRANGEMENT SHOWING CONNECTION FROM AIR COMPRESSOR TO RECUPERATOR.

ALSO. METHOD OF ATTACHING COMPRESSOR TO TRAIL.

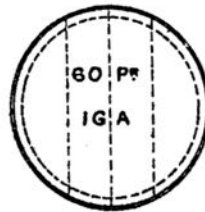
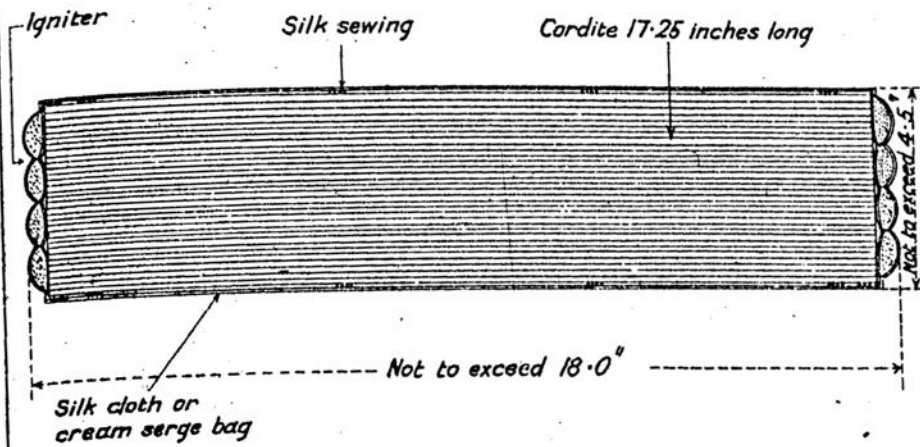


- B. Compressor air portable.
- C. No 2 Vertical air pump.
- D. Pipe connecting compressor to recuperator.
- E. Pressure gauge.
- F. Adapter.
- G. Securing bars.
- H. Slide housing recuperator body.
- J. Cradle.

Note. Later carriages will be issued with a lengthened adapter to bring the pressure gauge beyond the rear end of the cradle.

CARTRIDGE, B.L. 60 PR 9.LB. 7.OZS. CORDITE M.D.
OR R.D.B. SIZE 15, MARK III.

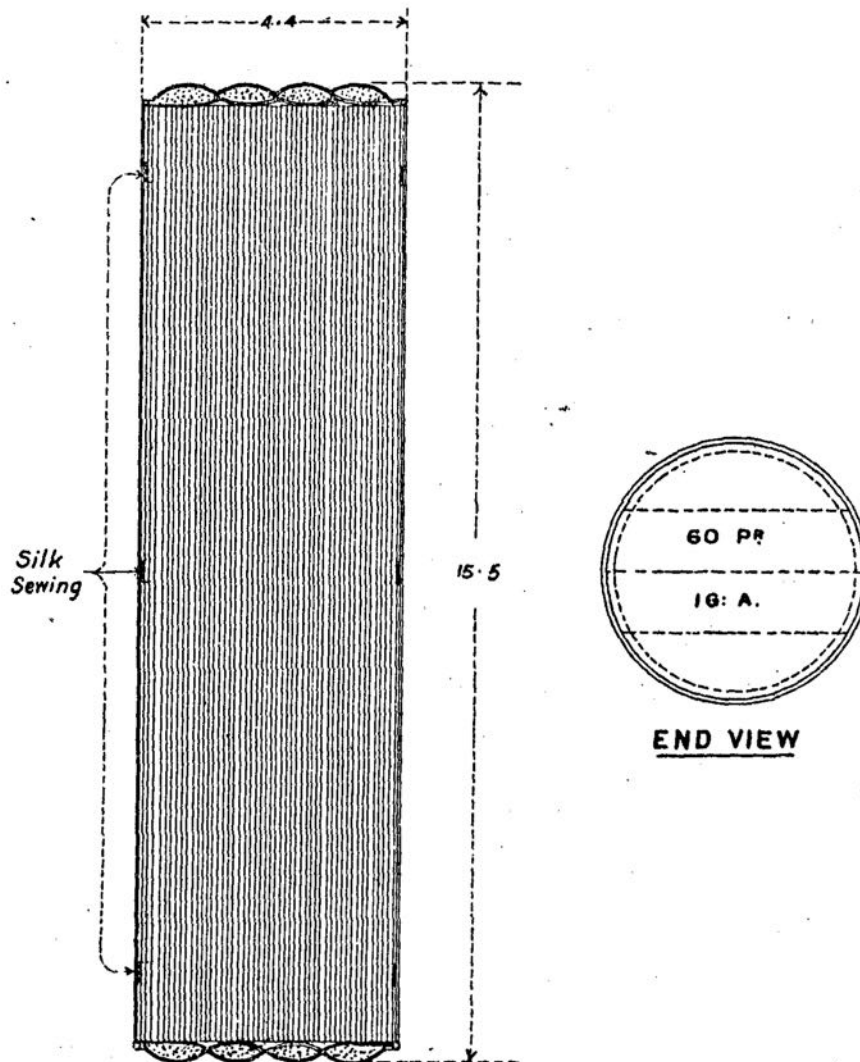
SCALE $\times \frac{1}{4}$



END VIEW

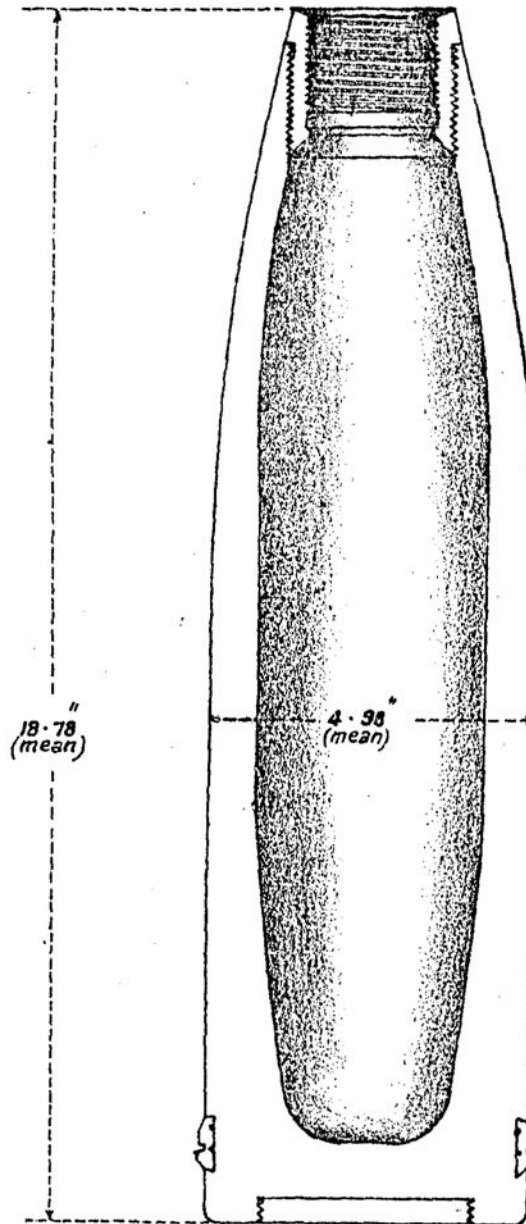
CARTRIDGE, B.L., 60 PR 6 LB. 6 OZS. CORDITE M. D. OR
R. D. B. SIZE 11, MARK I.
(REDUCED CHARGE)

SCALE = $\frac{1}{3}$

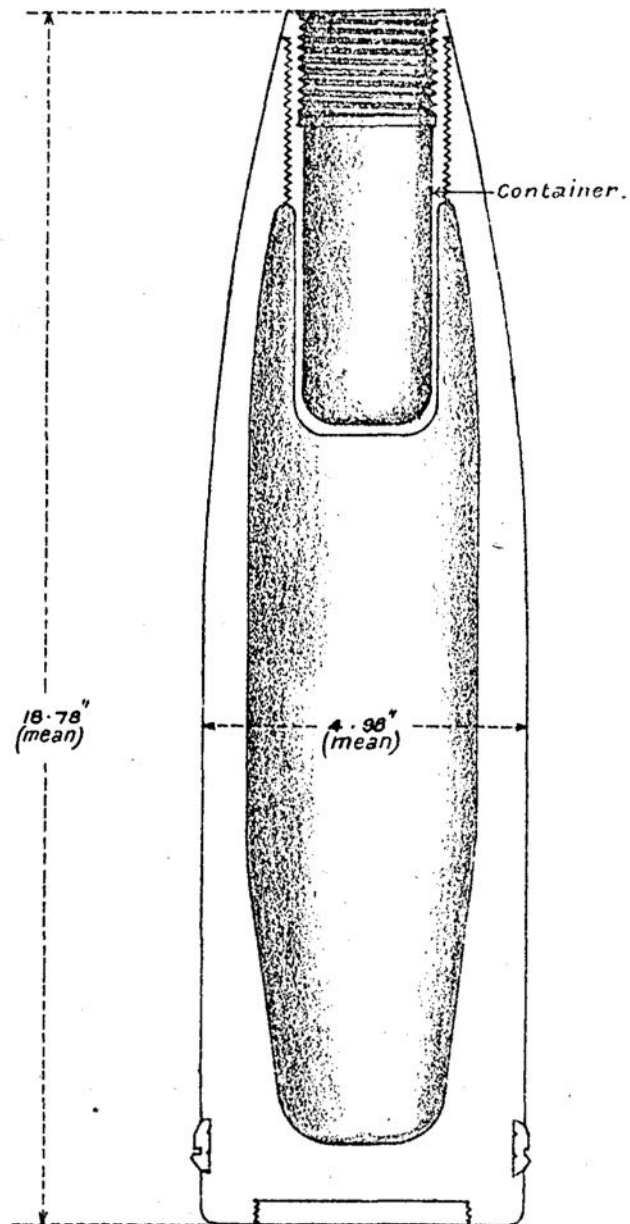


SHELL, B. L., HIGH EXPLOSIVE, 60 P^{rs}, MARK IX C.

SCALE = $\frac{1}{3}$

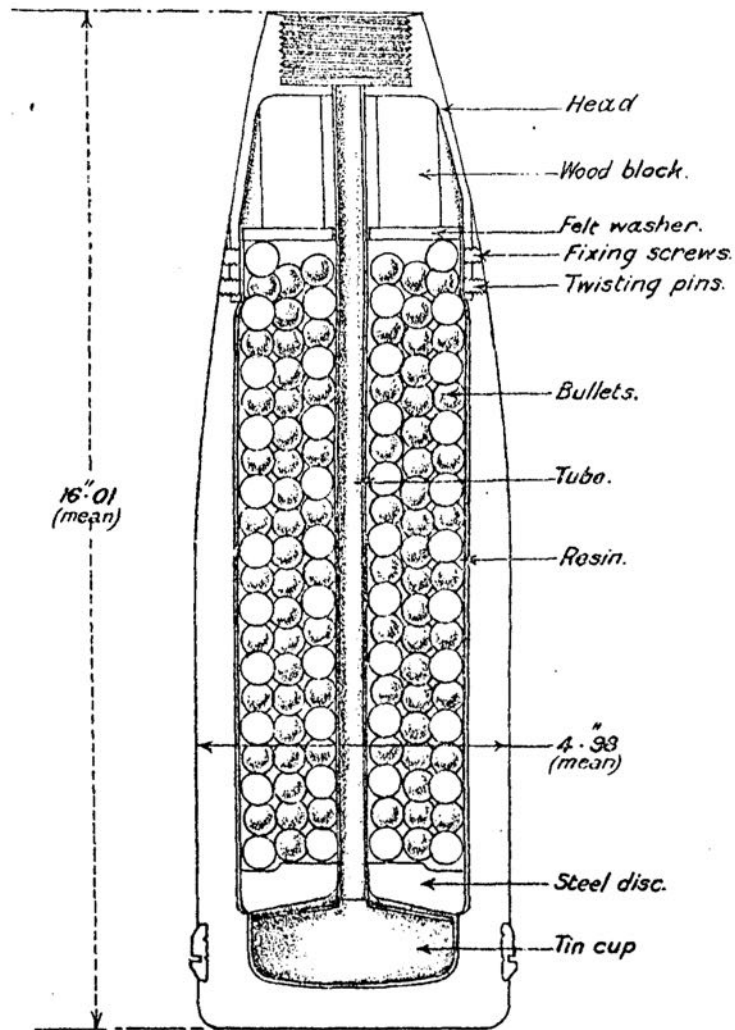


SHELL B. L., GAS, 60 PR. MARK V.



SHELL, B. L., SHRAPNEL, 60-PR, MARK IV C.

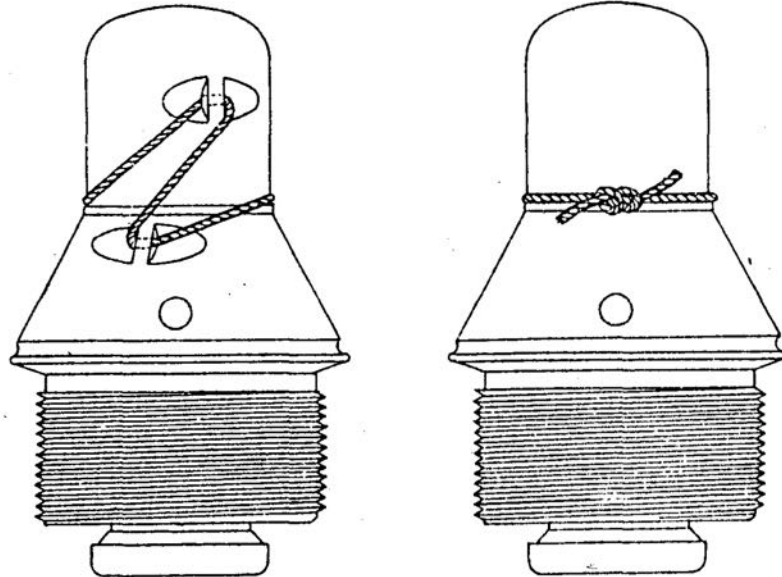
SCALE $\frac{1}{3}$



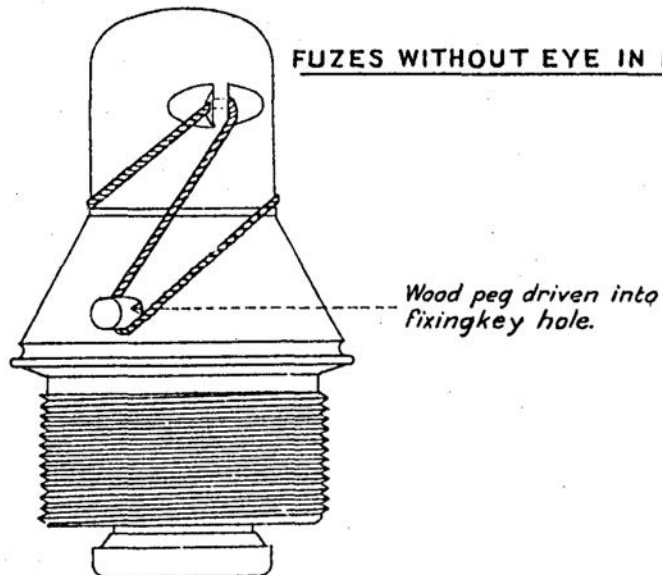
FUZES, PERCUSSION, D.A. N^{os} 106 AND 106^E

METHOD OF SECURING CAP WITH CORD

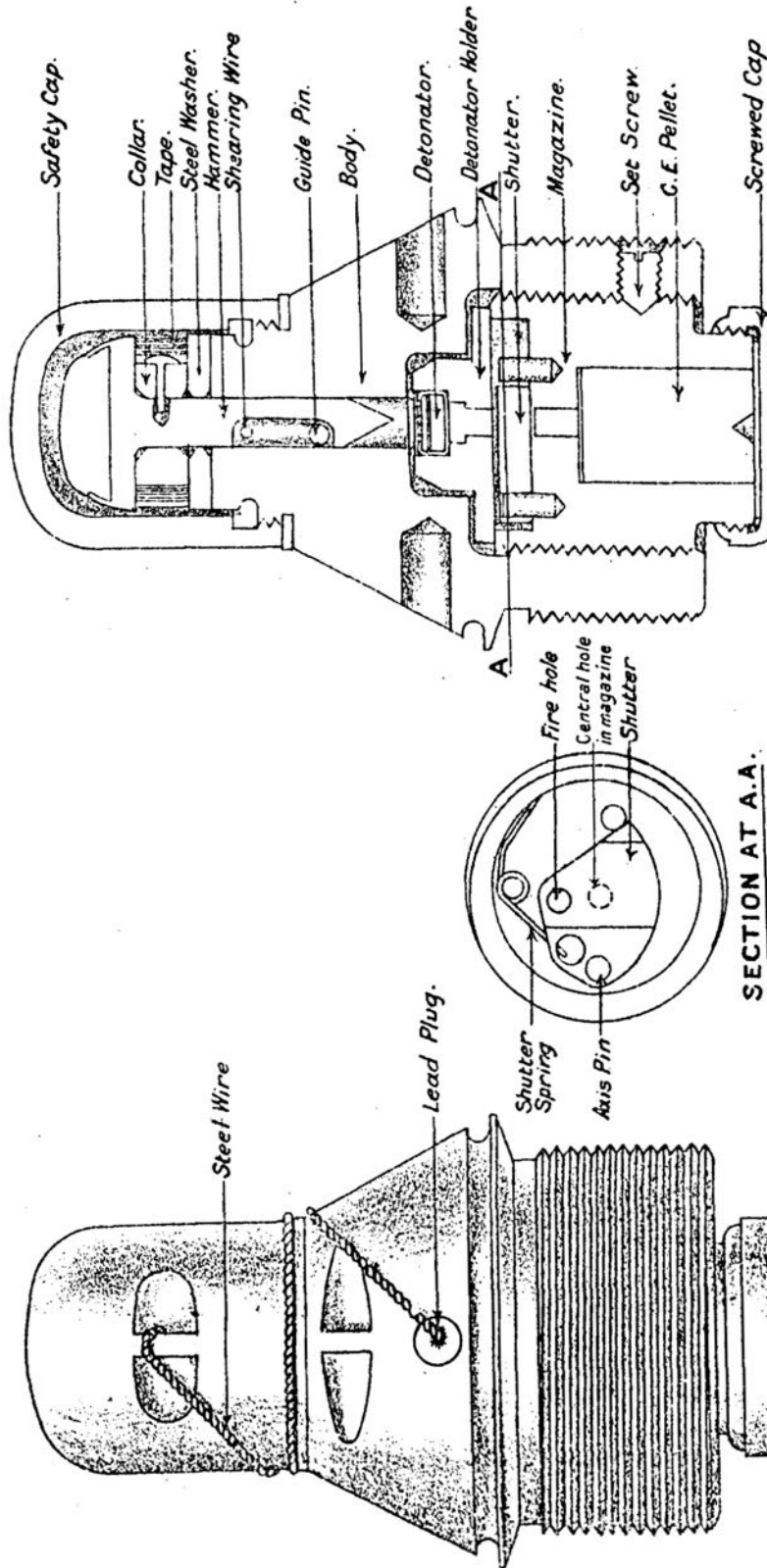
FUZES WITH EYE FORMED IN BODY.



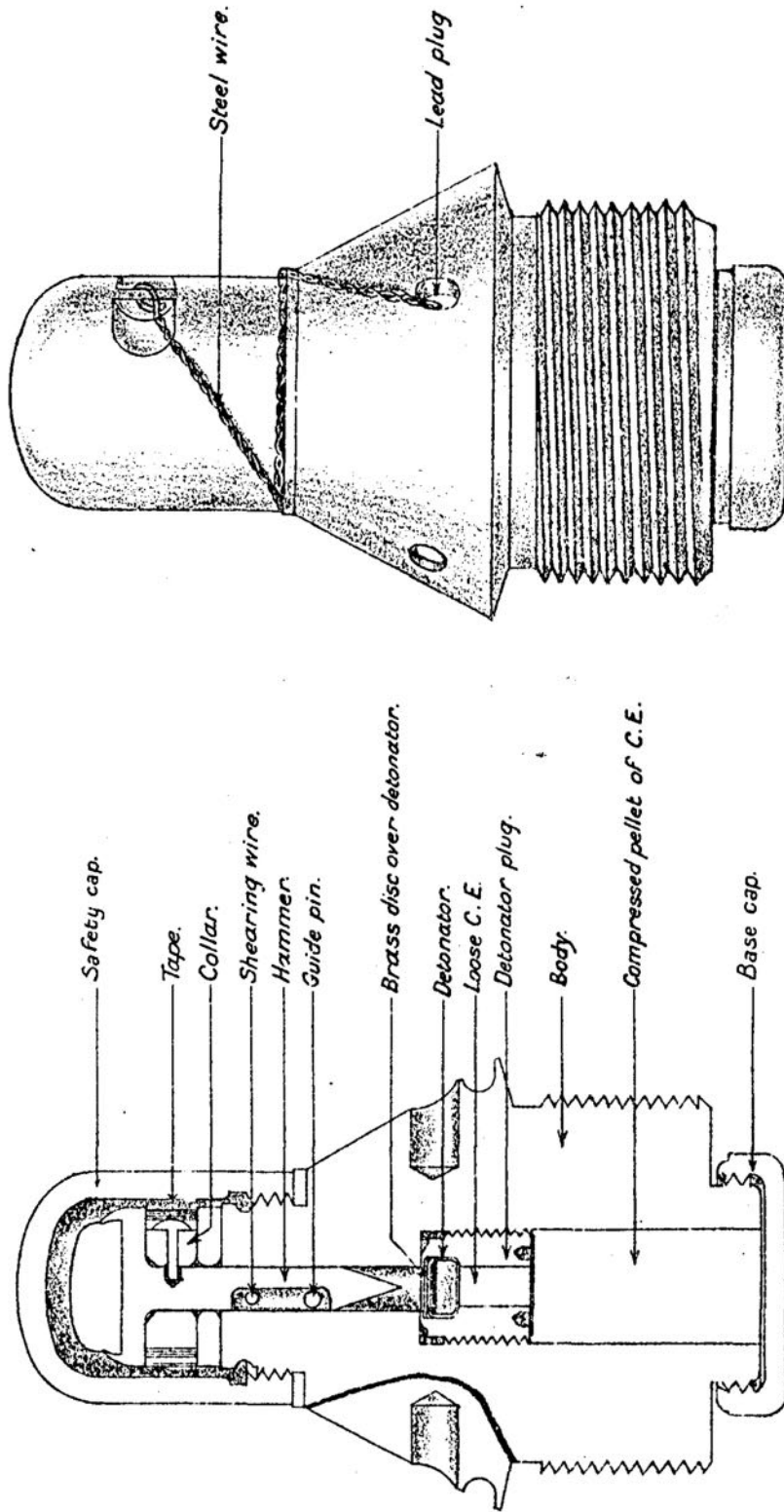
FUZES WITHOUT EYE IN BODY



FUZE, PERCUSSION, D.A. N° 106, E. MARK IV.

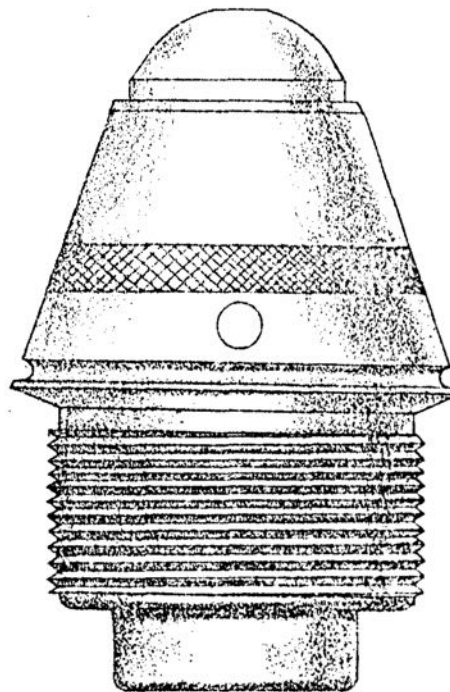
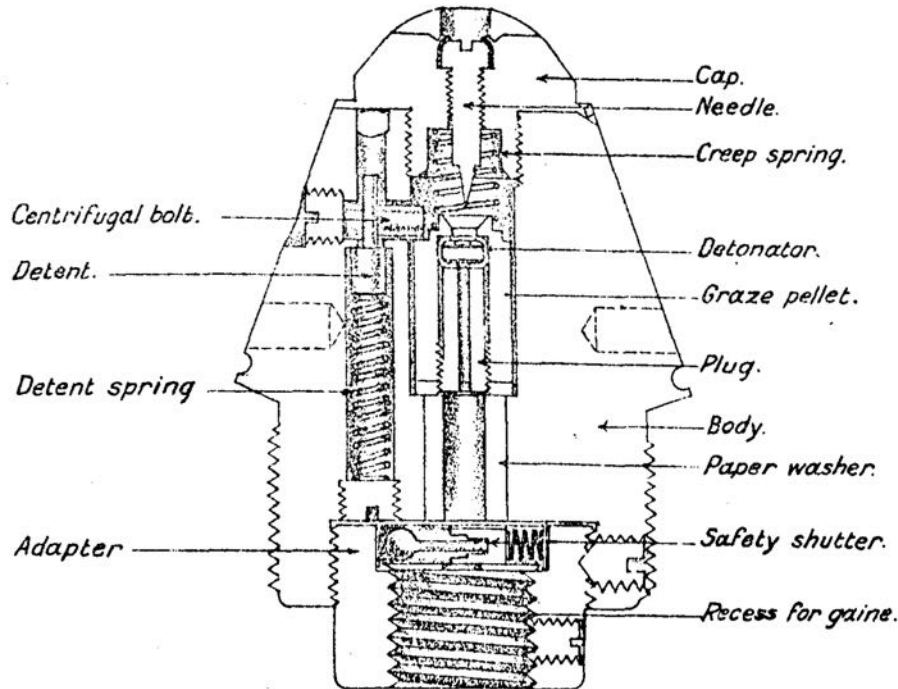


FUZE, PERCUSSION, D.A. N° 106, MARK V.



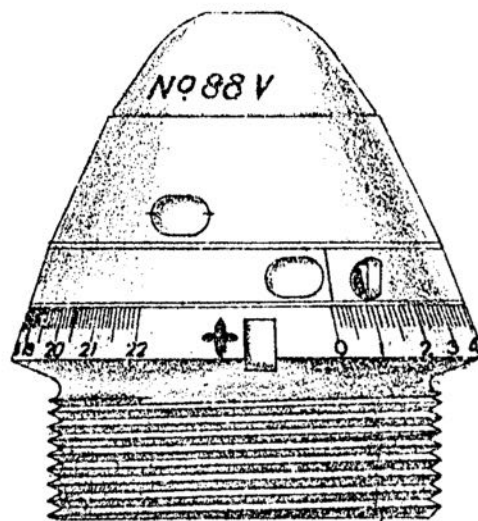
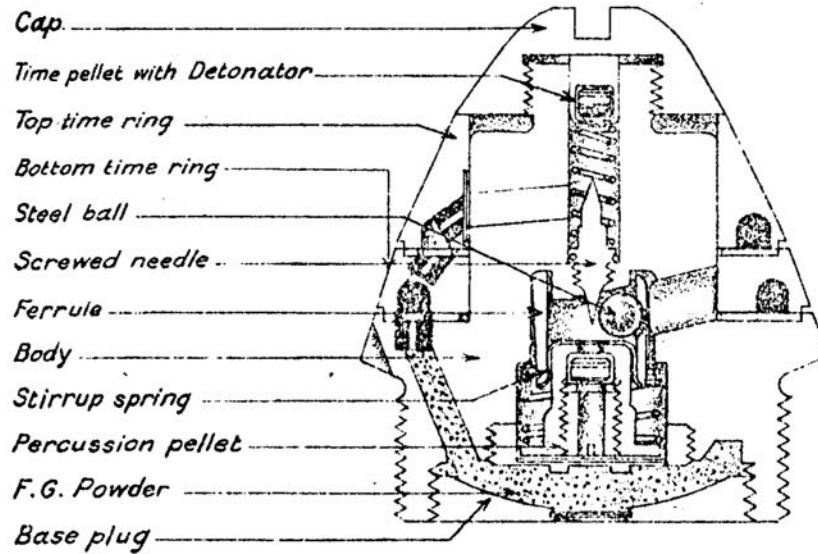
FUZE, PERCUSSION, N° 101 E, MARK II.

SCALE FULL SIZE.



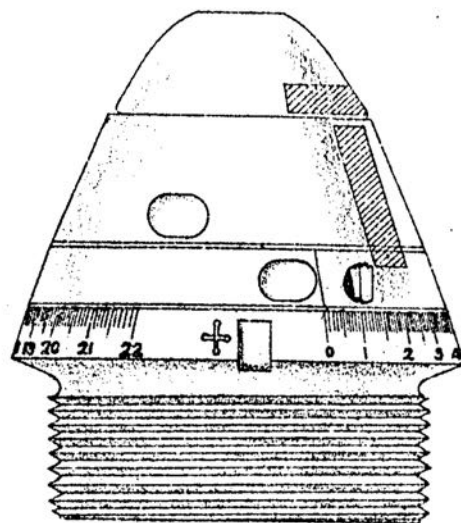
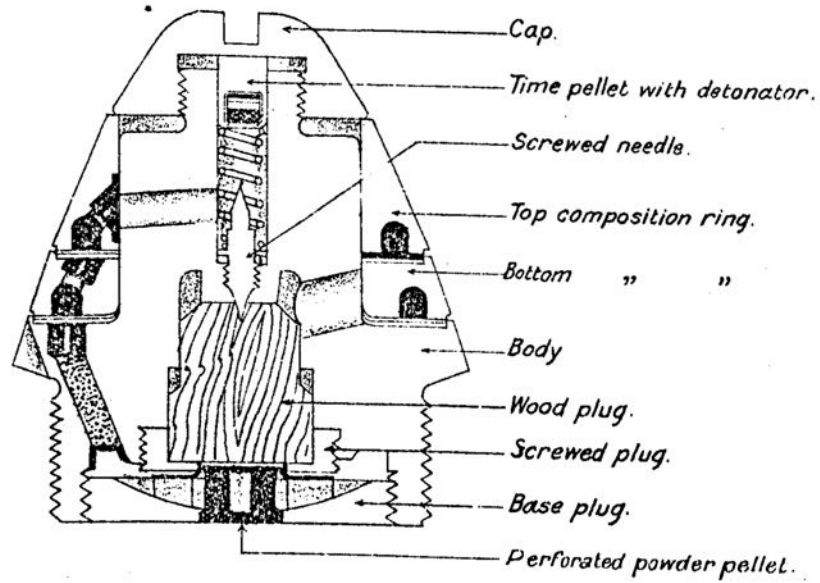
FUZE, TIME & PERCUSSION N°88 MARK V.

FULL SIZE.



FUZE, TIME, N° 188 M. MARK V.

FULL SIZE



TUBE, PERCUSSION, S. A. CARTRIDGE, MARK I.

SCALE = $\frac{2}{1}$

